2002 Long-Term Surveillance and Maintenance Program REPORT

U.S. Department of Energy
Grand Junction Office
Grand Junction, Colorado

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Long-Term Surveillance and Maintenance Program 2002 Report

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Large front cover photograph:

An aerial photograph of the Weldon Spring, Missouri, Site.

Cover insert photographs (clockwise from top):

A barbed-wire fence was installed to enclose and protect a supplemental standards area at Monticello, Utah.

Access control to the Rifle, Colorado, Disposal Site was improved by installing a new steel fence and gate.

An LTSM Program inspector describes successful stream bank stabilization efforts at the Canonsburg, Pennsylvania, Disposal Site to a visiting German stewardship engineer.

Contents

This report was prepared by the S.M. Stoller Corporation for the U.S. Department of Energy Grand Junction Office under DOE Contract Number DE–AC13–02GJ79491.

Acronyms

AEC	U.S. Atomic Energy Commission
BONUS	Boiling Nuclear Superheating [research reactor]
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980 or Superfund Program [42 *United States Code* (U.S.C.) 9601, *et seq.*]
CFR	*Code of Federal Regulations*
D&D	Decontamination and Decommissioning
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
FUSRAP	Formerly Utilized Sites Remedial Action Program
GEMS	Geospatial Environmental Mapping System
LTSM	Long-Term Surveillance and Maintenance [Program]
NRC	U.S. Nuclear Regulatory Commission
NWPA	Nuclear Waste Policy Act of 1982 (42 U.S.C. 10101, *et seq.*)
PCBs	polychlorinated biphenyls
RCRA	Resource Conservation and Recovery Act of 1976 (42 U.S.C. 6901, *et seq.*)
UMTRA	Uranium Mill Tailings Remedial Action [Project]
UMTRCA	Uranium Mill Tailings Radiation Control Act of 1978 (42 U.S.C. 7901, *et seq.*)

Structure of the DOE Long-Term Stewardship Program

The U.S. Department of Energy (DOE) provides stewardship services for low-level radioactive disposal and remediated sites to ensure that those sites do not cause harm to the public or the environment. Responsibilities for the DOE Long-Term Stewardship Program have increased as cleanup is completed at more sites and those sites transition to a long-term stewardship phase.

The DOE Long-Term Stewardship Program consists of three functional elements: policy and guidance, science and technology, and operations. Assignment of these functional elements is explained in the following paragraphs.

Policy and Guidance—The Office of Long-Term Stewardship in the DOE Headquarters Environmental Management Office of Science and Technology establishes stewardship policy and guidance, oversees all Department stewardship activities, and is the interface between field stewardship operations, DOE Headquarters, and other government agencies and entities.

Administration—Stewardship operations conducted by the DOE Grand Junction Office Long-Term Surveillance and Maintenance (LTSM) Program are coordinated and administered by the DOE Office of Long-Term Stewardship. The DOE Idaho Operations Office administers the DOE Grand Junction Office.

Science and Technology—DOE is conducting research into improved long-term care strategies and methods. The Grand Junction Office LTSM Program, in cooperation with other entities, conducts applied field research and performance evaluation.

Operations—The LTSM Program at the DOE Grand Junction Office conducts stewardship operations at sites where the selected remedy has been implemented and, consequently, protectiveness has been achieved. DOE continues to assign long-term stewardship responsibilities for sites or portions of sites that do not have a DOE mission after cleanup to the Grand Junction Office LTSM Program. Assignment of site responsibility to the LTSM Program ensures cost minimization and uniform compliance with applicable regulations, licenses, and agreements within DOE.

Long-term stewardship will also be required at DOE sites that have an ongoing mission. At those locations, the LTSM Program or site management will be responsible for stewardship of remediated units under the direction of the DOE Office of Long-Term Stewardship or the site's Program Secretarial Office.

The U.S. Department of Energy Grand Junction Office was designated as the Long-Term Surveillance and Maintenance Program office in 1988.

FOREWORD

Long-Term Surveillance and Maintenance Program Notes

The Long-Term Surveillance and Maintenance (LTSM) Program at the U.S. Department of Energy (DOE) Grand Junction Office continues to play a crucial role in DOE's Long-Term Stewardship Program. We conduct stewardship operations for closed sites with no future mission and provide support and input to the DOE stewardship program gained through more than 14 years of practical stewardship experience. LTSM Program responsibilities continue to grow as DOE completes remediation at more sites and transitions them to long-term stewardship.

In 2002, four sites were transferred to the custody of the LTSM Program for postclosure care: two Formerly Utilized Sites Remedial Action Program sites, located in Madison, Illinois, and Buffalo, New York; the former uranium ore-processing site at Grand Junction, Colorado, a site remediated under Title I of the Uranium Mill Tailings Radiation Control Act; and the Comprehensive Environmental Response, Compensation, and Liability Act site located at Weldon Spring, Missouri. The LTSM Program is responsible for the postclosure care of 33 sites.

The October 2002 transfer of the Weldon Spring Site was a significant accomplishment. Transition activities began in 2002 and will continue in 2003. An integral part of the transition effort has been the development of a long-term stewardship plan for the site. DOE is holding public work sessions with stakeholders (regulators, federal and state agencies, and local citizens) at the site with the goal of producing a comprehensive and effective stewardship plan that ensures the protectiveness of public health and the environment. The plan is expected to be finalized in 2003 following a decision on the remedy for ground water contaminated by former processing operations.

Two pilot projects to improve methods for stakeholders to access site information were successfully completed by the LTSM Program in 2002 and expanded into fully functional Internet applications. One pilot project resulted in the development of the Geospatial Environmental Mapping System, an interactive mapping and data delivery system on the LTSM Program website. Geographic information and analytical data for 29 sites were installed on the website. The other pilot project demonstrated the effectiveness of providing site documents on the Internet. By the end of 2002, key documents for 33 sites were posted to the LTSM Program website, including 474 Administrative Record documents for the Weldon Spring Site. We look forward to your input on making these tools useful to all users.

The Grand Junction Office continues to support DOE Headquarters in policy formulation and guidance development for the DOE Long-Term Stewardship Program. We believe we have contributed to making better and more useful policy. This activity includes developing protocols for site transition to stewardship, estimating the future cost of stewardship, and helping to coordinate interagency arrangements for postclosure care.

Our goal is to continue ensuring the protection of current and future generations by providing comprehensive and efficient stewardship services for low-level radioactive disposal and remediated sites. To bring you up to date, highlights of LTSM Program responsibilities and activities for 2002 are presented in this report. More information about program activities, stewardship sites, and information systems are available on the LTSM Program website at **http://www.gjo.doe.gov/programs/ltsm**.

Art Kleinrath, LTSM Program Manager
DOE Grand Junction Office

Introduction

Immense volumes of radioactive waste were created by the Federal Government and private industry in support of national defense, research, and civilian power-generation programs. If not controlled, much of this legacy waste will remain hazardous indefinitely. Our society has an obligation to safely control the radioactive waste and to inform and train future generations to maintain and, perhaps, improve upon the protections we establish. Current technology does not allow us to render this waste harmless, so the available methods to control risk rely on consolidation, isolation, and long-term oversight and care.

A program to identify and remediate legacy waste was embarked upon by the Federal Government. The U.S. Department of Energy (DOE) is custodian for much of the radioactive and other hazardous waste under control of the Federal Government. Other government agencies are responsible for additional sites where radioactive and other hazardous material are impounded or contained.

Remedial action is considered complete at a radioactive waste site when the material is isolated and the selected remedial action remedy is in place and functioning. Radioactive or other hazardous materials remain in place as part of the remedy at many DOE sites. To maintain protection from the material, DOE created a stewardship organization whose mandate is to maintain the remedy for the duration of the hazard and to manage risk.

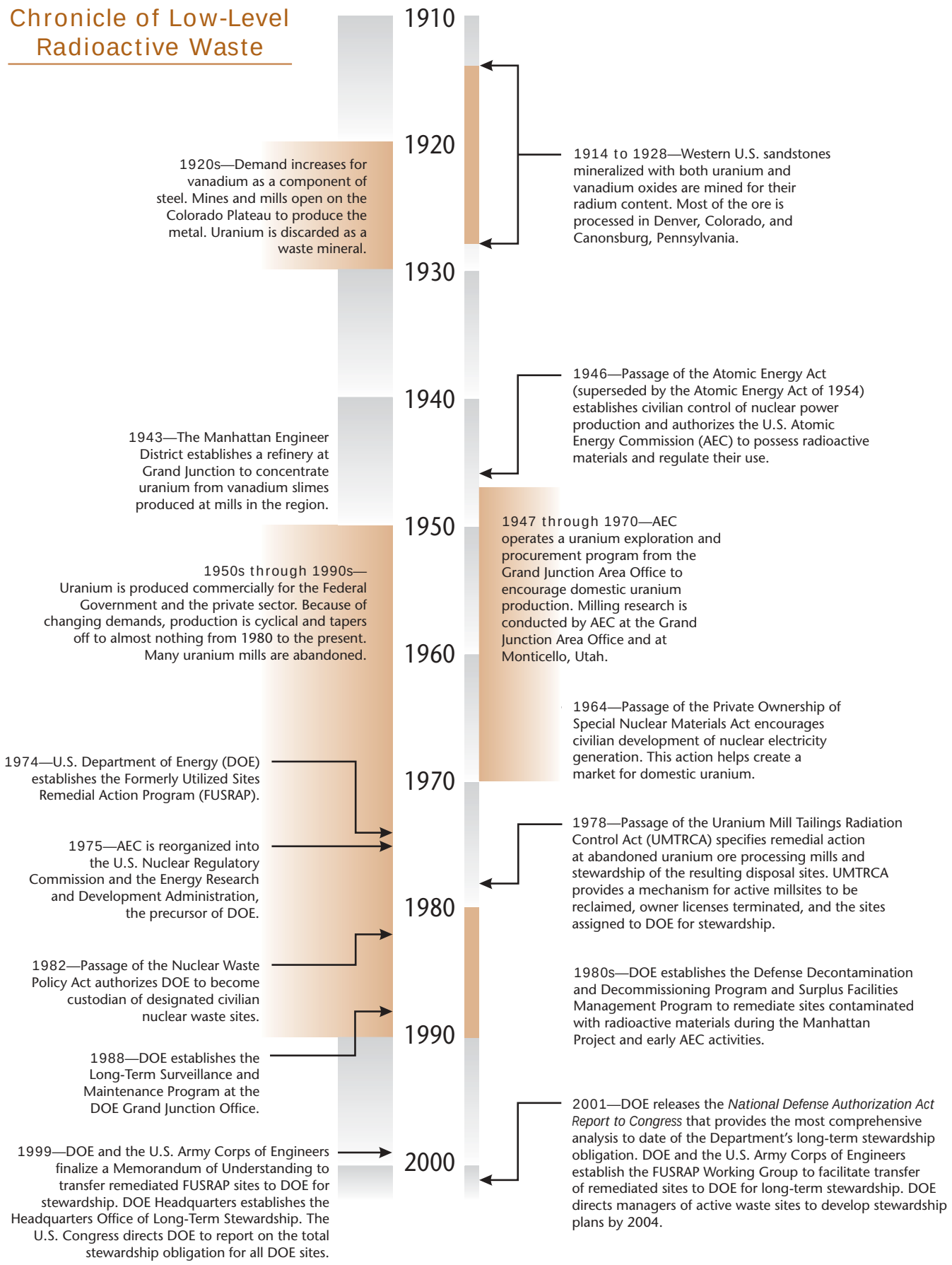
Stewardship for radioactive waste sites can be defined as the collection of actions necessary to maintain protection of public health and the environment. These actions include maintaining physical impoundment structures in good repair to ensure they perform as designed. Stewardship also includes preventing exposure to the wastes by maintaining access restrictions and warnings and recording site conditions and activities for future custodians. Any action, therefore, that will prevent exposure to the radioactive waste now or in the future is part of stewardship.

The Weldon Spring Site, near St. Louis, Missouri, was a uranium-concentrate processing facility (circa 1960s).

Remediated uranium mill tailings sites were among the first waste-control facilities to be placed into long-term custody and care. In 1988, DOE Headquarters assigned responsibility for these and other sites to the DOE Grand Junction Office, designating it as the Long-Term Surveillance and Maintenance (LTSM) Program office.

The mission of the LTSM Program is to fulfill DOE's responsibility to implement all activities necessary to ensure regulatory compliance and to protect the public and the environment from long-lived wastes associated with the nation's nuclear energy, weapons, and research activities. Key components of the LTSM Program include stakeholder participation, site monitoring and maintenance, records and information management, and research and technology transfer. This report presents summaries of activities conducted in 2002 in fulfillment of the LTSM Program mission.

Chronicle of Low-Level Radioactive Waste



Stewardship Operations at DOE Low-Level Radioactive Material Sites

The U.S. Congress has identified environmental cleanup of contaminated U.S. Department of Energy (DOE) sites as one of the Department's fundamental roles. In many cases, individual sites were contaminated as a result of historic operations involving radioactive ores and refined material. DOE has identified those sites where low-level radioactive contamination exists, and cleanup at many of those sites is under way or has been completed.

If a site can be remediated to a condition that poses no residual risk under any usage scenario, DOE can release it for unrestricted use. However, hazardous material must be left at many sites because of technological or economic constraints. At some sites, the processing areas are cleaned to unrestricted use and waste is placed in on-site disposal cells. For these sites, DOE establishes a stewardship program of postremediation care to protect human health and the environment from the hazards that remain. Such a program may include restricting certain future uses of the site, controlling access to the site, and keeping the public informed of remaining contaminants and associated hazards.

Contaminated DOE sites were remediated under different environmental restoration programs, each with its own regulations and standards. In each case, specific regulations, general environmental laws, and DOE orders establish standards and limits for protection of workers, the public, and the environment. The scope of stewardship operations for individual sites will vary, depending on site conditions when remedial action was completed and regulatory requirements. All locations that cannot be released for unrestricted use require long-term care. For sites that can be free released, the long-term steward is responsible for records management tasks.

DOE Headquarters recently reaffirmed the past policy that requires all contaminated sites to consider stewardship requirements when selecting a remedy. The Department recognizes that remedy selection will drive stewardship requirements. Because of the longevity of hazards at many DOE sites, a savings in remedy cost may be exceeded many times over by increased postremediation care requirements. However, in some cases, stewardship operations may consist essentially of monitoring long-term storage and controls until a technology is developed to render wastes less hazardous.

Site Transition to Long-Term Stewardship

Sites will transition to long-term stewardship when the selected remedy has been successfully implemented. This transition may occur while ground water treatment is ongoing or when only monitoring is required to assess the progress of natural remediation processes.

The DOE Grand Junction Office Long-Term Surveillance and Maintenance (LTSM) Program participates in development of guidance establishing protocols for transition of remediated sites to long-term stewardship. DOE Headquarters facilitates coordination between the Grand Junction Office and other sites and programs to ensure that essential site knowledge is transferred along with stewardship responsibility for the site. Such coordination is a benefit of more than a decade of site transition experience acquired by the Grand Junction Office and ensures a thorough and efficient process.

LTSM Program staff members work directly with remediation program managers to develop long-term stewardship plans and transition procedures. These activities may start years before completion of remedial action so that essential information is captured while knowledgeable remediation personnel are still available. Program personnel identify and obtain necessary records to conduct ongoing stewardship and often develop a long-term surveillance plan or a long-term stewardship plan for the site.

LTSM Program personnel, in coordination with the U.S. Army Corps of Engineers, supervise real property transfers or acquisition of site access. Site-handoff inspections allow stewardship personnel to gain site knowledge from remediation personnel and ensure that the site complies with stipulated requirements.

Maintaining the Remedy

A hazardous waste site remedy is selected that ensures protection of public health and the environment and compliance with applicable laws and regulations. As steward, the LTSM Program must ensure that the sites remain protective and compliant. Program systems and activities are designed to meet these goals.

LTSM Program Stewardship Activities

LTSM Program personnel conduct site surveillance and monitoring activities in accordance with approved site-specific long-term surveillance plans, stewardship plans, or management plans. Records of stewardship activities are maintained for the benefit of future stewards.

Ground water is sampled at the Weldon Spring, Missouri, Site to monitor cell performance and legacy contamination.

Inspections

DOE conducts periodic site inspections to assess site integrity and the effectiveness of institutional controls; to determine the need for maintenance, follow-up inspections, or other intervention; and to ensure regulatory compliance. Inspectors are selected on the basis of site characteristics and issues. For example, engineers will be included on inspection teams at sites with erosion or drainage concerns. Botanists will inspect sites where revegetation or plant encroachment issues have been identified.

Inspectors observe surficial site characteristics. Site concerns are often indicated by changes in surface conditions. For instance, changes in slope configuration (e.g., settling or slumping) or new vegetation patterns may indicate a modifying process that should be investigated. Inspectors also evaluate site access restrictions, erosion resistance of remediated surfaces, cover rock durability, and vegetation conditions.

Inspection frequency is driven by site conditions, trends, and regulatory requirements. Annual inspections are conducted at Uranium Mill Tailings Radiation Control Act Title I and Title II sites as a condition of the general license under which DOE operates these sites. When not established by regulation or Department policy and guidance, inspection frequency is determined by a best management practice.

The LTSM Program informs regulators of site inspection schedules through direct correspondence and by posting schedules on the LTSM Program website at **http://www.gjo.doe.gov/programs/ltsm**. Inspection results also are posted on the program's website for access by all interested stakeholders.

Monitoring

LTSM Program activities include monitoring of ground water and other environmental media. Monitoring requirements are specified in site-specific long-term surveillance plans. Additional monitoring may be conducted in response to site-specific conditions.

DOE may conduct ground water monitoring to assess disposal cell performance or to track the extent and characteristics of legacy ground water contamination. Monitoring may be conducted to evaluate the condition of vegetation with respect to slope stability or to monitor vegetation encroachment on cell covers and in drainage structures where vegetation must be controlled to maintain design performance. Program personnel might also conduct air or wildlife monitoring.

Monitoring results are evaluated as they are received and are considered in conjunction with inspection results to assess the condition and performance of site containment systems or the progress of natural processes. Monitoring results are reviewed to ensure regulatory compliance, distributed to interested stakeholders, posted on the LTSM Program website, and archived.

Records Administration

One of the primary functions of long-term stewardship is to preserve site knowledge by managing site records effectively. Activities at each site are documented. This information is archived at the DOE Grand Junction Office facility and will be available to future custodians. Records that describe baseline conditions are acquired from remedial action contractors before site transfer. Ongoing surveillance and monitoring results are preserved so trends may be evaluated. Records are maintained in National Archives and Records Administration-compliant storage areas and are indexed and tracked with an electronic database.

Maintenance

Disposal sites are designed to require only minimal maintenance for the duration of their design lives. Typically, only minor maintenance is needed because most site structures are relatively new. As the sites age, however, they will require routine replacement of wear items such as fencing and signs.

The LTSM Program has conducted several major maintenance interventions to repair or improve erosion control structures; however, in no case was the containment integrity of a disposal cell threatened.

Should a disposal site receive severe damage or a cell sustain catastrophic failure, DOE will undertake the necessary corrective action. The LTSM Program maintains contacts with local law enforcement officials near each site who will notify DOE in case of an incident or emergency. Signs with the DOE Grand Junction Office 24-hour phone number [(970) 248–6070] are posted at each site.

Institutional Controls

Institutional controls are legal or administrative mechanisms, such as deed restrictions, restrictive easements, or zoning laws, that limit exposure to site hazards (see sidebar on page 23). When invoked, these controls are often a critical part of the selected remedy package and must remain effective to ensure protectiveness. LTSM Program personnel regularly assess site-specific institutional controls for effectiveness. Assessment includes working with local county recorders to update lists of adjacent property owners, ensuring that property owners and local officials remain aware of hazards and institutional controls, and keeping local law enforcement agencies informed of contact information for program staff members.

Stakeholder Services

The LTSM Program encourages stakeholder involvement in program operations. Stakeholders consist of all interested parties for a given site, including local residents, regulators, elected officials, federal and state agencies, Native American tribes, and the general public. The program has implemented the *LTSM Program Public Participation Plan*, which is an appendix to the *Long-Term Surveillance and Maintenance Program Plan* posted on the Internet at **http://www.gjo.doe.gov/programs/ltsm** under "General," "Program Information."

Stakeholder services include responding to requests for information, providing easy access to information on the DOE Grand Junction Office LTSM Program website, and holding public meetings and work sessions during the development and implementation of stewardship activities. LTSM Program services also include participating in national and international seminars and symposia and

German Steward Visits LTSM Program

In September 2002, Jochem Becker of Rheinbraun Engineering und Wasser GmbH visited the DOE Grand Junction Office and the Canonsburg, Pennsylvania, Disposal Site. Mr. Becker is active in managing Germany's uranium mining and processing waste—a Cold War legacy. His company supports Wismut GmbH, the German state uranium processing company, and the German Federal Ministry of Technology and Economics. The purpose of his visit was to exchange technical information about long-term care of remediated uranium ore-processing sites.

Maintenance requirements for an erosion control feature at the Canonsburg site are explained to Jochem Becker.

In Grand Junction, Mr. Becker met with DOE Grand Junction Office program managers. His interests focused on ground water remediation, postclosure disposal cell performance, and land use. "Our technical and societal issues are similar to those faced by the German people and we can help each other reach our common goals for the environment and the public," said Don Metzler, the ground water technical manager for the DOE Grand Junction Office.

Mr. Becker accompanied LTSM Program personnel on the annual inspection of the engineered disposal cell at the Canonsburg site that was scheduled to coincide with his visit to the United States. This site was selected because the humid climate of western Pennsylvania is similar to the uranium-processing district in eastern Germany and because it is situated in an urban area similar to many of the German processing and disposal sites.

sharing technology and information with foreign stewardship programs (see sidebar).

Applied Research

The Grand Junction Office LTSM Program is in the unique position of possessing field experience with a wide variety of disposal sites. The program offers an opportunity to observe changes in site conditions over time and to study the interaction of a disposal site with its environment. Access to full-scale containment systems provides a valuable source of lessons learned that can be incorporated into improved stewardship methods or designs for new disposal impoundments. This facet of the LTSM Program operations is discussed in "Cover Monitoring and Long-Term Performance Project" on page 32.

Administrative Support

The Grand Junction Office LTSM Program has been in existence since 1988 and has accumulated cost and performance history for field stewardship operations. This experience allows the program to provide empirical data for stewardship cost estimates, transition processes, and policy and guidance.

The Grand Junction Office developed a schedule-based crosswalk for transitioning sites to the LTSM Program and a stewardship cost estimate for the Weldon Spring, Missouri, Site. Work performed by Grand Junction Office personnel has benefited development of DOE stewardship policy and guidance.

LTSM Program Planning and Implementation

Program Management

The Grand Junction Office LTSM Program activities are conducted in accordance with the *Long-Term Surveillance and Maintenance Program Plan*. This plan presents program mission and objectives, establishes responsibilities, identifies regulatory requirements, and defines strategies for achieving program goals. Guidance and plans for routine operations and extraordinary circumstances are identified. A major component of the program plan addresses public participation. The program plan is posted on the Internet at **http://www.gjo.doe.gov/programs/ltsm**.

Scope

Currently, the LTSM Program is responsible for annual surveillance, monitoring, and maintenance of 33 sites remediated under Title I and Title II of the Uranium Mill Tailings Radiation Control Act (UMTRCA); the Nuclear Waste Policy Act (NWPA) Section 151; the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA); the DOE Defense Decontamination and Decommissioning (D&D) Program; and the Formerly Utilized Sites Remedial Action Program (FUSRAP).

By the close of fiscal year 2006, the Grand Junction Office LTSM Program expects to provide stewardship services for 69 sites. Approximately 50 more sites could be transferred to the LTSM Program after 2006. Descriptions of the remedial action programs and the sites governed by their respective regulations are provided in this report. The table below and bar graphs on page 8 present anticipated program scope through 2006.

In addition, the LTSM Program inspects, maintains, and tracks usage of calibration facilities for surface and downhole radiation

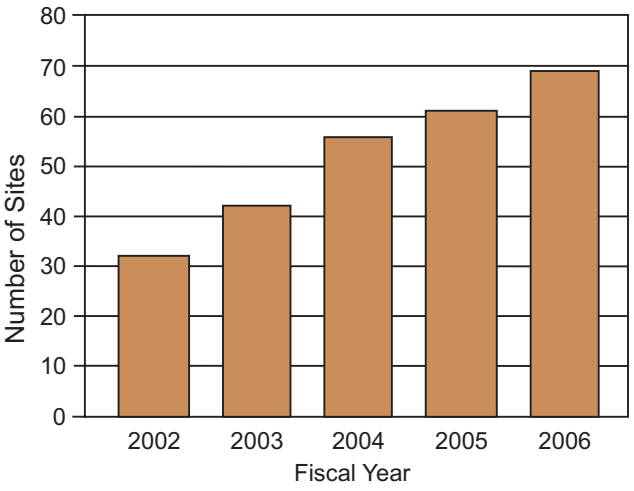
Summary of Sites in LTSM Program Custody

	Fiscal Year				
Program or Site	2002	2003	2004	2005	2006
UMTRCA Title I Disposal and Processing Sites[a]	21	26	31	31	31
UMTRCA Title II Disposal Sites	3	6	13	17	20
NWPA Section 151(c) Site	1	1	1	1	1
D&D Sites	4	5	5	5	5
FUSRAP Sites[b]	2	2	4	5	7
CERCLA Sites[c]	1	2	2	2	5
Total	32	42	56	61	69

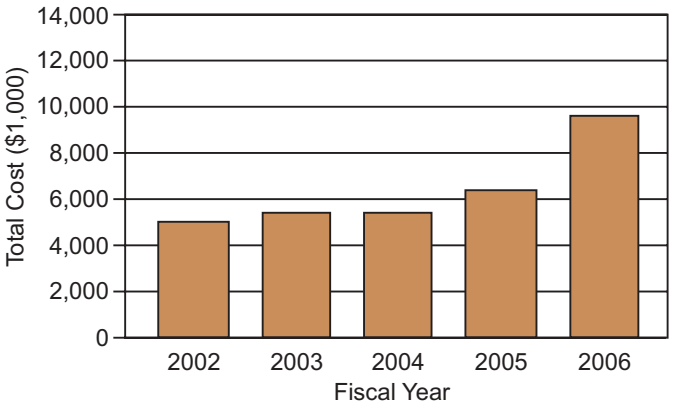
[a]The totals for Title I sites include the Grand Junction, Colorado, Disposal Site, which will accept waste until as late as 2023. The site will not be licensed until it is closed.

[b]In the 2001 *A Report to Congress on Long-Term Stewardship*, DOE estimated that the 21 FUSRAP sites being remediated by the U.S. Army Corps of Engineers will require long-term care. The 25 FUSRAP sites where DOE completed remediation were not identified as requiring long-term stewardship. The LTSM Program will have a records management responsibility for all 46 sites.

[c]Two discrete CERCLA sites at Monticello, Utah, are counted as a single site for program planning purposes. The Weldon Spring, Missouri, Site was added to the LTSM Program in October 2002 (fiscal year 2003).



Sites in LTSM Program Custody



Projected LTSM Program Cost

Actual cost shown for fiscal year 2002.

detection instruments. These facilities include borehole models at the Grand Junction Office facility; calibration pads at Walker Field Airport in Grand Junction; and field calibration facilities in Casper, Wyoming; Grants, New Mexico; and George West, Texas.

Program Budget

Funding for the Grand Junction Office LTSM Program is acquired through an annual DOE Grand Junction Office budget request. LTSM Program costs will increase from $5,030,000 in fiscal year 2002 to approximately $9,600,000 in fiscal year 2006 as the number and complexities of sites increase. These values include all costs to DOE for stewardship of LTSM Program sites, such as administrative fees paid to regulators and contracting costs.

LTSM Program Issues and Initiatives

FUSRAP

DOE and the U.S. Army Corps of Engineers are testing protocols for transfer of completed Formerly Utilized Sites Remedial Action Program (FUSRAP) sites to DOE for long-term stewardship. Issues, including identification and transfer of records, development of long-term surveillance plans, and preparation of budget requirements, were addressed in preparation for DOE to provide stewardship services for the 21 sites remediated by the U.S. Army Corps of Engineers. The responsibilities for two remediated sites, located at Madison, Illinois, and at the Bliss and Laughlin facility in Buffalo, New York, were transferred to DOE in 2002.

National Stewardship Support

The LTSM Program has hosted national stewardship workshops and field demonstrations for American and foreign members of the stewardship community. LTSM Program personnel also review guidance and policy documents and agreements in support of DOE Headquarters.

Long-Term Surveillance Plan Revisions

As conditions change at a site, the site-specific long-term surveillance plan must be revised to implement new or eliminate unnecessary surveillance and monitoring requirements. Revisions to a plan require concurrence by regulators before implementation. The revised Burrell, Pennsylvania, Disposal Site long-term surveillance plan, which received U.S. Nuclear Regulatory Commission (NRC) concurrence in 2002, allows vegetation to grow naturally on the disposal cell cover to help maintain its water balance and decreases surface water and ground water monitoring requirements. The Lakeview, Oregon, Disposal Site long-term surveillance plan was revised to incorporate a recalculated minimum rock diameter of the protective riprap cover and was submitted to NRC for concurrence. Long-term surveillance plans are also being revised for disposal sites at Canonsburg, Pennsylvania (see page 19), and Falls City, Texas (see page 20), to incorporate recently approved ground water compliance strategies, and at Lowman, Idaho (see page 22), to discontinue ground water monitoring.

Pilot Projects

The LTSM Program completed two pilot projects funded by DOE Headquarters. These projects developed improved methods and infrastructure to manage and access program and site records and geographic and monitoring information.

Information management and access are fundamental to effective long-term control of hazardous material. The records pilot project entailed (1) developing external access to select portions of the DOE Grand Junction Office Records Log System and (2) identifying, scanning, formatting, and posting a subset of hard-copy records on the LTSM Program website. In addition, an interface is being maintained with the DOE Oak Ridge Operations Office and the DOE Nevada Operations Office that are also implementing information management pilot studies.

The second pilot project addressed development of a web-enabled geographical information system for the sites currently under stewardship of the Grand Junction Office LTSM Program. This Internet-based system allows interactive mapping of site features and display of technical information on a site-by-site basis.

Monitor Well Documentation and Decommissioning

Monitor well information has been entered into an electronic database to manage well access, permit, and status information. The LTSM Program began decommissioning unneeded monitor wells in 2000 and continued the project in 2002. A total of 41 monitor wells and standpipes were decommissioned in 2002 at the disposal sites at Burrell and Canonsburg, Pennsylvania, and Maybell, Naturita, and Slick Rock, Colorado. An additional 34 monitor wells were decommissioned at the Grand Junction, Colorado, Processing Site.

DOE will continue to decommission monitor wells at disposal sites as monitoring requirements are reduced and as regulators approve ground water compliance plans for processing sites. Approximately 900 unneeded monitor wells are expected to be decommissioned, which reduces liability for DOE and results in cost savings where access fees are no longer paid.

LTSM Program Featured Activities

Weldon Spring Site Transitions to Long-Term Stewardship

DOE began remediating the former uranium-concentrate processing facility located near Weldon Spring, Missouri, in 1986. The federal property, known as the Weldon Spring Chemical Plant, included 44 abandoned buildings and several process waste lagoons and was contaminated with radioactive waste, asbestos, solvents, and other hazardous material. Prior development and use of the facility by the U.S. Army for the production of explosives also contaminated the site. A nearby limestone quarry, used by the Army and the U.S. Atomic Energy Commission (a predecessor agency to DOE) as a disposal site, contained contaminated building debris and drummed and bulk wastes. Site production and processing activities also resulted in the contamination of a nearby drainage and ground water under both locations.

The Weldon Spring Chemical Plant and the Weldon Spring Quarry sites, listed by the U.S. Environmental Protection Agency (EPA) on the National Priorities List in 1987 and 1990, respectively, were remediated in accordance with Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requirements. These requirements included assessment of site conditions and risks and selection of appropriate remedies.

DOE completed construction of the disposal cell at the Weldon Spring, Missouri, Site in 2002.

Approved remedies for completed operable units consisted of remediating the chemical plant, quarry, and affected vicinity properties; consolidating solid wastes in an engineered disposal cell; and monitoring ground water contaminated by disposal activities at the quarry. DOE has not yet selected a remedy to address contaminated ground water beneath the chemical plant site but anticipates a decision in 2003. However, in its current condition and use, the Weldon Spring Site presents no unacceptable risks to the public or the environment.

Although it is located near a fast-growing urban area, the Weldon Spring Site is surrounded by undeveloped land that is maintained as state-owned conservation areas. DOE worked with the State of Missouri to convert project haul roads into recreational trails and incorporate them into the existing public trail system.

Stakeholders were involved in all aspects of the remedy selection and remediation process and continue to be involved with decisions concerning the site. For example, the Weldon Spring Citizens Commission, established in 1986 and funded by DOE, reviews and comments on project documents, holds regular meetings, and provides a mechanism for public input into remedy and stewardship decision making.

DOE transitioned the completed portions of the Weldon Spring Site to the LTSM Program in October 2002. Development of a long-term stewardship plan is essential to monitoring and maintaining the site, and a draft of the plan was prepared and provided to stakeholders for review and comment in August 2002. Activities involved in development of the plan include

- Working with and soliciting input from regulators and members of the local stewardship community (see sidebar).

Public Participation Key to Weldon Spring Site Transition to Long-Term Stewardship

Site transition is a gradual process designed to incorporate regulatory requirements and to address input and concerns of local citizens. Building upon previous work conducted as part of the Weldon Spring Site Remedial Action Project, the LTSM Program led the preparation of a draft long-term stewardship plan and released it for stakeholder comment on August 9, 2002. To promote expedient distribution and encourage comments, DOE posted the draft plan on the Internet and offered paper copies to stakeholders.

DOE hosted a public workshop at the Weldon Spring Site on August 28, 2002. Key aspects of the draft plan were presented, followed by question-and-answer sessions. When possible, specific questions were addressed by site remediation and stewardship experts. DOE recorded the questions and comments and solicited additional written comments from stakeholders after the workshop.

More than 750 questions and comments on the draft plan, including those addressed during the workshop, were received by DOE. DOE prepared a response to each item and published all questions and comments and their respective responses on the Internet to enable stakeholders to read and evaluate them for further discussion. Because of the volume and comprehensive nature of the questions and comments, DOE committed to host three focus area public work sessions to provide additional opportunities for stakeholder input.

Two work sessions, focusing on communications and institutional controls, were hosted in October and December 2002. Participating in the sessions were regulators, representatives of the Weldon Spring Citizens Commission, members of the public, the Director of the DOE Office of Long-Term Stewardship, and DOE and contractor personnel from the Weldon Spring Site and the Grand Junction Office. In early 2003, DOE will host the third work session to address current and long-term monitoring and maintenance at the site.

DOE hosted public work sessions (above) at the Weldon Spring, Missouri, Site Interpretive Center (right) to discuss the site long-term stewardship plan.

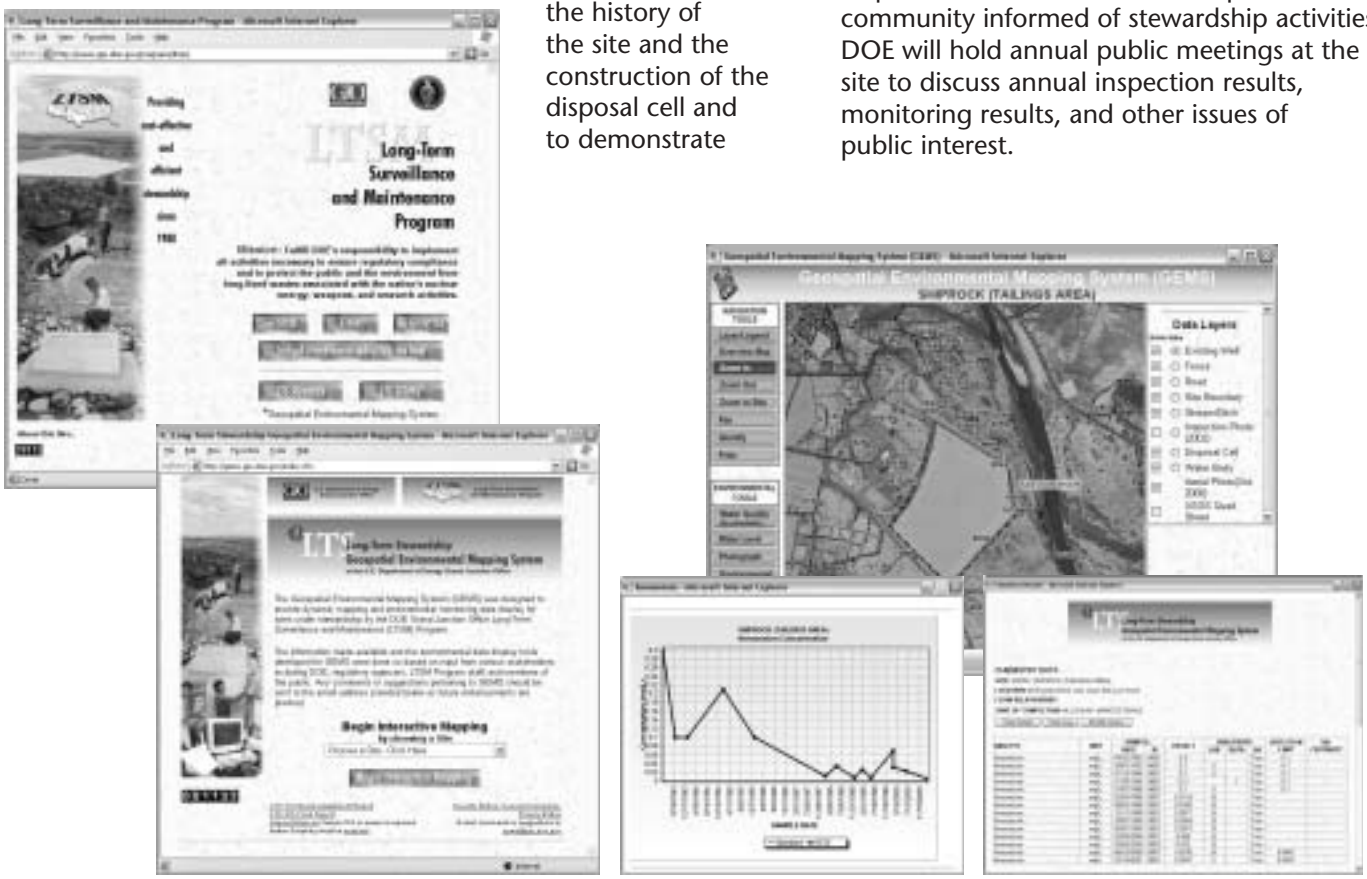
Changes and commitments resulting from the input provided by the stakeholders will be incorporated into the long-term stewardship plan. This process will result in a more comprehensive and effective stewardship plan that will ensure protectiveness of the public health and the environment.

- Documenting the knowledge and experience of personnel involved in site remediation.
- Identifying and archiving essential site documents.
- Identifying and incorporating geographic and analytical data into existing LTSM Program systems.
- Planning site monitoring and maintenance activities to meet stewardship requirements.
- Transferring or establishing permits and agreements to conduct the work.
- Developing and implementing legally enforceable institutional controls to maintain site protectiveness.

A key part of site stewardship is to keep the public informed about site history and final site conditions. DOE built a stepped path to the top of the disposal cell and placed informational monuments there to inform the public about the history of the site and the construction of the disposal cell and to demonstrate the safe condition of the site. DOE also established an Interpretive Center adjacent to the disposal cell that presents a comprehensive site history, descriptions of site wastes and remediation, and documentation of the selected remedies and final site conditions.

Record documents and historical monitoring data are available on the LTSM Program website (**http://www.gjo.doe.gov/programs/ltsm**). The website will be updated as new reports and data are generated. DOE also will continue to maintain the Weldon Spring Site Remedial Action Project website (**http://www.wssrap.com**) as long as the stewardship community is interested in learning about the remediation process that occurred at the Weldon Spring Site.

DOE continues to maintain an office at the Weldon Spring Site. The expertise of personnel at the site is required for successful completion of the remedy selection for the chemical plant ground water contamination and the site transition to the LTSM Program. As part of its commitment to keep the local community informed of stewardship activities, DOE will hold annual public meetings at the site to discuss annual inspection results, monitoring results, and other issues of public interest.



Long-Term Stewardship Geospatial Environmental Mapping System website.

Public Information Through the Internet

DOE posted the initial Internet website for the LTSM Program in 1999 and continues to enhance it and incorporate new information as it becomes available. The website is designed to provide essential stewardship information directly to stakeholders, along with several methods for contacting program personnel for additional information and answers to specific questions.

DOE Headquarters awarded pilot study grants to the LTSM Program in 2001 to test the viability of two Internet-based systems for disseminating stewardship information to all interested stakeholders. Both studies successfully demonstrated that DOE could deploy these technologies at reasonable cost, thereby offering stakeholders immediate access to site information from remote locations. In 2002, DOE expanded the systems to include information for all LTSM Program sites. These tools are available on the LTSM Program website at **http://www.gjo.doe.gov/programs/ltsm**.

Geospatial Environmental Mapping System

One pilot study was designed to provide a web-based geographic information system that resulted in the development of an interactive mapping and data system referred to as the Geospatial Environmental Mapping System (GEMS). The information made available and the environmental data display tools developed for GEMS incorporate input from various stakeholders, including DOE, regulatory agencies, LTSM Program personnel, and members of the public.

Currently, users can selectively query the database containing geographic information and site data for 29 LTSM Program sites. Data layers that can be displayed on GEMS, if available for the site, include the site or disposal cell boundary, roads, fences, existing monitor wells, streams and ditches, bodies of water, annual site inspection photographs, aerial photographs, and U.S. Geological Survey quadrangle maps. Updated water quality and water level data can be obtained for monitor wells, and the user can display and print the data in table and graph formats.

Records

The second study explored the feasibility of providing stewardship documents on the Internet. As a result, users can now search a suite of records and can select a document of interest to view, print, or download. Documents that cannot be viewed on the website can be requested during the same interactive session.

Currently, a core collection of documents has been installed on the Long-Term Stewardship Records website for 33 LTSM Program sites. By the close of 2002, 474 documents from the Weldon Spring Site Administrative Record were posted in their entirety on the website.

Long-Term Stewardship Records website.

LTSM Program Accomplishments

The LTSM Program is responsible for providing stewardship services for DOE sites that have no active ongoing mission. All sites assigned to the DOE Grand Junction Office for custody and care continue to be protective of public health and the environment and in compliance with applicable laws, regulations, and policies. The following accomplishments are highlights of LTSM Program activities in 2002.

Routine Inspection, Maintenance, and Monitoring

- Inspected 29 sites and prepared reports of site conditions. Conducted monitoring of ground water quality, ground water level, vegetation, precipitation, radon, and permit compliance as required by long-term surveillance plans or according to best management practices.
- Performed routine maintenance at 19 sites, including replacing signs, repairing or replacing damaged monuments, repairing fences, cutting encroaching vegetation, mowing grass, and controlling noxious weeds.
- Repaired a cell-dewatering pump at the Rifle, Colorado, Disposal Site to maintain compliance pumping.

Storm runoff damage to a diversion channel at the Mexican Hat, Utah, Disposal Site was repaired by DOE.

- Closed out the storm water discharge permit for a restored borrow area at the Naturita, Colorado, Disposal Site because of successful revegetation.
- Received concurrence from the Navajo Nation to reduce the monitoring frequency of ground water seeps at the Mexican Hat, Utah, Disposal Site from a quarterly basis to an annual basis for cell performance monitoring.
- Received U.S. Nuclear Regulatory Commission (NRC) concurrence for a revised long-term surveillance plan for the Burrell, Pennsylvania, Disposal Site.
- Revised the long-term surveillance plan for the Lakeview, Oregon, Disposal Site and submitted it to the NRC for concurrence.
- Began preparation of a revised long-term surveillance plan for the Lowman, Idaho, Disposal Site.
- Operated the cell at the Grand Junction, Colorado, Disposal Site in April and May. Approximately 5,150 cubic yards of low-level radioactive tailings and other approved wastes were disposed of in the cell.
- Submitted the Comprehensive Environmental Response, Compensation, and Liability Act 5-year review reports for the Monticello, Utah, sites to the U.S. Environmental Protection Agency (EPA) and the Utah Department of Environmental Quality.
- Submitted the 2002 annual Uranium Mill Tailings Radiation Control Act (UMTRCA) Title I and Title II disposal site inspection and monitoring compliance reports to NRC.
- Continued to operate treatment cells at the Durango, Colorado, Disposal Site to test the effectiveness of using zero-valent iron to remove uranium and other contaminants from transient drainage water. Test results have been used to design and install permeable reactive barriers at the Monticello, Utah, mill tailings site and at Travis Air Force Base in California.

Nonroutine Maintenance

- Surveyed property corners and installed boundary monuments at the Maybell, Colorado, Disposal Site.
- Installed additional rock armoring in a drainage at the Maybell, Colorado, Disposal Site to reduce erosion.
- Conducted a follow-up inspection of storm damage at the Mexican Hat, Utah, Disposal Site and restored a diversion channel to design conditions.
- Installed a new steel fence and gate across the access road to the Rifle, Colorado, Disposal Site to discourage trespassing and prevent site vandalism.
- Decommissioned 75 unneeded monitor wells and standpipes at six sites.

Transition of New Sites to Long-Term Stewardship

- Submitted the draft long-term stewardship plan for the Weldon Spring, Missouri, Site to stakeholders for review and comment. The site was transferred to the LTSM Program in 2002.
- The Grand Junction, Colorado, Processing Site was transferred to the LTSM Program in 2002.
- The Bliss and Laughlin Site in Buffalo, New York, and the Madison, Illinois, Site were transferred to the LTSM Program in 2002.
- Prepared a presentation and attended briefings regarding remedial actions and stewardship plans for the Fernald Environmental Management Project in Ohio.
- Reviewed the 2002 radiological survey report for the decommissioned Boiling Nuclear Superheating (BONUS) research reactor in Rincón, Puerto Rico, to become familiar with the radiological conditions of the site in anticipation of site transfer to the LTSM Program.
- Provided transition assistance to UMTRCA Title II site licensees in preparation for transfer of the Shirley Basin South, Wyoming; Bear Creek, Wyoming; and L-Bar, New Mexico, uranium ore-processing sites.

Stewardship Program Administration

- Provided review comments on institutional controls and real property transfer procedures for the Commonwealth of Pennsylvania's offer to sell the "Area C" parcel that is located adjacent to the Canonsburg Disposal Site.
- Compiled law enforcement and real property records contacts for all LTSM Program sites.

Stakeholder Services

- Conducted a public workshop and two focused public work sessions to discuss stakeholder comments on the draft long-term stewardship plan for the Weldon Spring, Missouri, Site.
- Maintained the LTSM Program Internet site. Visitors to the website can obtain site information, program plans, and reports and can access DOE Headquarters and other stewardship sites (**http://www.gjo.doe.gov/programs/ltsm**).
- Developed the Geospatial Environmental Mapping System (GEMS) for the LTSM Program website. GEMS provides dynamic mapping and environmental monitoring data display for LTSM Program sites.
- Developed the Long-Term Stewardship Records system for the LTSM Program website. This tool allows stakeholders to view, print, and request documents for LTSM Program sites.
- Presented stewardship information to and participated in various sessions and workshops at the Waste Management 2002 Symposium.
- Posted fact sheets for the Grand Junction, Colorado, Office Facility and the Salt Lake City, Utah, Processing Site to the LTSM Program website.
- Posted the technical report *Results of Drilling Activities and Resolution of Ground Water Issues at the Mexican Hat, Utah, UMTRA Project Site* to the LTSM Program website.

- Participated in the Interstate Technology Regulatory Council fall meeting in Washington, DC. The focus of the meeting was on state regulator stewardship concerns.

Applied Research

- Contributed to the DOE Office of Science and Technology project Long-Term Stewardship Science and Technology Roadmap by documenting research needs for the design and long-term stewardship of containment facilities.
- Contributed to the DOE Office of Science and Technology project Technical Targets: A Tool to Support Strategic Planning in the Subsurface Contaminant Focus Area by leading and contributing to breakout groups responsible for writing sections for *Advanced Sustainable Containment Systems*, *Integrated Storage-Treatment Concepts*, *and Effective and Sustainable Technological Solutions for Contaminant Plumes.*

An LTSM Program scientist places a soil lift in a small weighing lysimeter at Monticello, Utah, for a study of alternative cover designs.

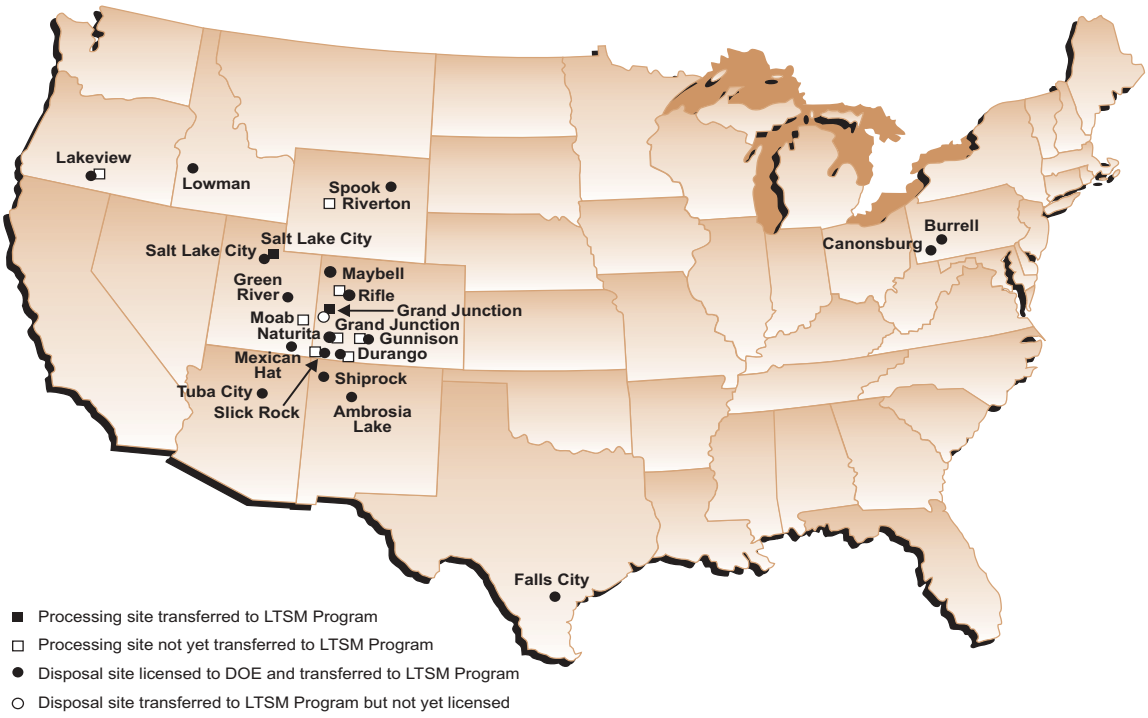
- Continued to work with the DOE Office of Science and Technology on a guidance document for use by DOE weapons sites to design landfill covers that are intended to last hundreds to thousands of years.
- Continued collaboration with the EPA Alternative Cover Assessment Program through the EPA National Risk Management Laboratory on analysis of water balance data from the caisson lysimeters and the 7.5-acre repository cover lysimeter at Monticello, Utah. Data include drainage measurements, water storage change, precipitation, soil moisture profiles, indoor and outdoor temperature profiles, potential evapotranspiration rates, vegetation composition, canopy cover, biomass productivity, and leaf area index.
- Continued collaboration with EPA Region 8 on a study of evapotranspiration covers and capillary barrier designs using small weighing lysimeters at Monticello, Utah.
- Began collaboration with EPA Region 8 on a study of the water storage capacity of potential borrow soils for a disposal cell cover design for uranium ore mill tailings at Moab, Utah.
- Continued collaboration with the DOE Office of Science and Technology on a case study of the ecology and ecophysiology of the vegetated disposal cell cover at Monticello, Utah.
- Continued collaboration with the DOE Office of Science and Technology on a study of natural analogs of long-term soil development, ecological change, and climate change at the Monticello, Utah, Disposal Site as part of the Long-Term Engineered Cover Project.
- Completed a study of the effects of degradation and reduction of the size of riprap on the disposal cell side slopes at the Lakeview, Oregon, site. This activity included evaluating the rock-size calculation input parameters pertaining to infiltration, runoff velocity reduction, and precipitation rate.
- Completed laboratory analyses for a study of the ecology, soil water balance, and long-term performance of the cell cover at the Lakeview, Oregon, Disposal Site.

- Completed an evaluation of data collected at the Lowman, Idaho, Disposal Site to determine if contaminants are likely to leach from interred radioactive sand and contaminate ground water at the site if plant roots breach the engineered cover.

Publications, Presentations, and Reports

- Published "Evolution of Cover Systems for the Uranium Mill Tailings Remedial Action Project, USA" in *Mine Water and the Environment* (Volume 20, pages 190–197).
- Submitted "Soil Water Balance and Plant Water Relations in Small Monolith Lysimeters at the Semiarid Monticello, Utah, Superfund Site" for publication in *Arid Land Research and Management.*
- Submitted "Chapter 20: Ecosystem Restoration" for publication in *Environmental Monitoring.*
- Presented "Monticello Field Lysimetry: Design and Monitoring of an Alternative Cover" at the Waste Management 2002 Symposium in Tucson, Arizona.
- Presented "Engineered Containment and Control Systems: Nurturing Nature" at the 22nd Annual Meeting of the Society for Risk Analysis held in New Orleans, Louisiana, and submitted the paper for publication in *Risk Analysis*. This paper was selected as a finalist for the "Best Paper Award" competition of the Society for Risk Analysis.
- Prepared the DOE Grand Junction Office technical report *Leaching Characteristics of Radioactive Sands: Long-Term Surveillance and Maintenance Program, Lowman, Idaho, Site.*
- Contributed to the DOE Idaho National Engineering and Environmental Laboratory technical report *Long-Term Stewardship Science and Technology Roadmap.*
- Prepared the DOE Grand Junction Office technical report *Characterization of Vegetation Within the 3-Hectare ACAP [Alternative Cover Assessment Project] Lysimeter at the Monticello, Utah, Superfund Site: 2001 Status Report.*
- Prepared the DOE Grand Junction Office technical report *Methodology for Determining Revegetation Success at the Monticello Repository.*
- Prepared the CERCLA-required 5-year review report *Second Five-Year Review Report for the Monticello Radioactively Contaminated Properties, Monticello, Utah, San Juan County, Utah.*
- Prepared the CERCLA-required 5-year review report *Second Five-Year Review Report for Monticello Mill Tailings (U.S. Department of Energy), City of Monticello, San Juan County, Utah.*
- Prepared the NRC-required LTSM Program report *2002 Annual Site Inspection and Monitoring Report for Uranium Mill Tailings Radiation Control Act Title I Disposal Sites.*
- Prepared the NRC-required LTSM Program report *2002 Annual Site Inspection and Monitoring Compliance Report for Uranium Mill Tailings Radiation Control Act Title II Disposal Sites.*
- Prepared the project report *Long-Term Stewardship Geographic Information System Pilot Project Final Report for the U.S. Department of Energy Grand Junction Office.*
- Prepared, in conjunction with Washington State University, the technical report *FY 2002 Work Plan for a Field Demonstration of Baseline Ecological Studies at the Monticello, Utah, Superfund Site: Revegetation Design, Performance Monitoring, and Effects of Ecological Change on Long-Term Cover Performance.*
- Contributed to the Desert Research Institute technical report *FY 2002 Work Plan for Natural and Archaeological Analog Studies at the CERCLA Waste Disposal Cell, Monticello, Utah: Effects of Climate Variability and Soil-Geomorphic Processes on Long-Term Cover Performance.*
- Contributed to the Desert Research Institute technical report *Future Climate States at Monticello, Utah.*

LTSM Program Projects and Sites



Locations of UMTRCA Title I Sites

UMTRCA Title I Disposal and Processing Sites

For Uranium Mill Tailings Radiation Control Act (UMTRCA) Title I disposal sites in the LTSM Program, DOE becomes a licensee to the U.S. Nuclear Regulatory Commission (NRC). Inspection, reporting, and record-keeping requirements are defined in Title 10 *Code of Federal Regulations* (CFR) Part 40.27, "General License for Custody and Long-Term Care of Residual Radioactive Material Disposal Sites." A general license for long-term custody is indefinite in duration. Usually, title for the land is assigned to an agency of the Federal Government, and the land is administratively withdrawn from unrestricted public use. Sites located on tribal land revert to tribal control, and DOE obtains a site access agreement with the tribe that allows DOE to fulfill its custodial responsibilities.

Residual radioactive material was removed from some of the Title I processing sites to off-site disposal locations. NRC does not require a license for remediated processing sites that do not have disposal cells; however, NRC is the regulator if contaminated ground water remains. These sites will be assigned to the LTSM Program for long-term custody and care when state or tribal regulators and NRC have approved the ground water compliance strategy. To date, the former uranium ore-processing sites at Grand Junction, Colorado, and Salt Lake City, Utah, have been assigned to the LTSM Program.

Title I of UMTRCA specified 24 inactive uranium ore-processing sites for remediation. Two of these sites, located in North Dakota, were delisted from UMTRCA at the request of that state and were not remediated by DOE. Remediation of the remaining 22 sites resulted in the creation of 19 disposal cells that contain encapsulated uranium mill tailings and associated contaminated material (see page 37).* Approximately 40 million

*Congress directed DOE to remediate the Moab, Utah, uranium mill tailings site under Title I of UMTRCA. Thus, Moab will become the 20th UMTRCA Title I disposal site.

cubic yards of low-level radioactive material are contained in engineered UMTRCA Title I disposal cells (see sidebar on page 20).

Standards for UMTRCA remedial action, cell performance, and ground water quality are established by the U.S. Environmental Protection Agency (EPA) in 40 CFR 192 "Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings." Upon NRC concurrence that remedial action has been completed and acceptance of the site-specific long-term surveillance plan, each disposal site comes under the DOE general license for long-term care. If ground water at a particular site was contaminated by former site activities, NRC will accept only the surface improvements under the general license; the site will not be fully licensed until ground water quality meets the applicable regulations. The NRC license mandates annual inspections of the disposal cells.

All but one of the Title I disposal cells, the Grand Junction, Colorado, Disposal Cell, have been licensed. A portion of the Grand Junction Disposal Cell will be left open under the Long-Term Radon Management Project that is managed by the DOE Grand Junction Office in conjunction with the LTSM Program.

A summary of the status of each UMTRCA Title I site is presented in this report; annual compliance reports and fact sheets are available on the LTSM Program website at **http://www.gjo.doe.gov/programs/ltsm** or from the LTSM Program office at the DOE Grand Junction Office.

Ambrosia Lake, New Mexico

Contaminated material was consolidated and encapsulated on the existing tailings pile. The riprap-armored disposal cell was closed in 1995. NRC has concurred that ground water quality conforms to the requirements of 40 CFR 192 through the application of supplemental standards. Therefore, NRC does not require ground water monitoring to determine compliance or cell performance at this location, and the site was fully licensed in 1998. At the request of the State of New Mexico, DOE samples two monitor wells once every 3 years and reports the analytical results to the state.

Burrell, Pennsylvania

Mill tailings were hauled to this location from the Canonsburg, Pennsylvania, site for use as fill. Because of the large volume of tailings on the Burrell site, a disposal cell was constructed on that site and is protected by a rock cover. The disposal site was accepted under the NRC general license in 1994. In 2002, NRC concurred with a revised long-term surveillance plan submitted by the LTSM Program. Revisions include elimination of the requirement for vegetation control on the cell cover and a reduction in ground water monitoring. DOE decommissioned two unneeded monitor wells at this site in 2002.

Canonsburg, Pennsylvania

DOE encapsulated low-level radioactive material from a former millsite and 163 vicinity properties in an engineered disposal cell in 1985. NRC accepted the site under the general license, and the site was transferred to the LTSM Program in 1996. The radon barrier of this urban disposal cell is protected by layers of rock and soil, and the surface was seeded with grass. Custodial maintenance at the Canonsburg Disposal Site includes fertilizing and mowing the grass within the site

Vegetation will no longer be controlled on the cover of the Burrell, Pennsylvania, Disposal Cell.

UMTRCA Title I Disposal Cells

In accordance with 40 CFR 192.32, UMTRCA Title I disposal cells are designed ". . . to provide reasonable assurance of control of radiological hazards to (i) Be effective for one thousand years, to the extent reasonably achievable, and, in any case, for at least 200 years, and, (ii) Limit releases of radon-222 from uranium byproduct materials to the atmosphere so as not to exceed an average release rate of 20 picocuries per square meter per second ($pCi/m^2 s$)."

Most cell bases were constructed with a barrier consisting of natural and, at some sites, synthetic materials to contain the waste material and prevent degradation of underlying soil and water. Each engineered cell cover was constructed with a radon barrier consisting of various types and thicknesses of natural and synthetic materials that allow the radon gas that is generated by the encapsulated material to decay to solid elements before it reaches the atmosphere. The design also prevents the infiltration of water into the cell that potentially could leach the contaminated material and degrade underlying soil and ground water.

The disposal cell at Spook, Wyoming, was constructed in an abandoned open pit uranium mine and graded to conform to the surrounding topography. Most disposal cells, however, were constructed partially above the natural grade and shaped into erosion-resistant geometric configurations. A layer of protective material consisting of durable rock (riprap), a combination of rock and soil, or select earthen material, depending on the environmental conditions at the site, was placed over and around the cells to prevent erosion of the covers or degradation of their performance.

boundary, thus ensuring the success of the grass cover and preventing erosion. Limited ground water and surface water monitoring will continue through 2003. DOE decommissioned 18 unneeded monitor wells at this site in 2002.

Durango, Colorado

DOE removed tailings, contaminated building debris, and soil from a former uranium ore-processing site located near the Animas River and from associated vicinity properties. The low-level radioactive material was encapsulated in the Durango Disposal Cell southwest of Durango in 1990. NRC accepted the disposal site under the general license in 1996. A vegetated rock-and-soil matrix layer protects the top slope of the cell; the side slopes are covered with riprap to protect against wind and water erosion. Deep-rooted plants are removed to prevent damage to the cell cover radon barrier, and a control method was initiated in 2002 to eliminate a noxious weed from the site. Ground water is monitored annually to confirm cell performance.

Falls City, Texas

Tailings from seven deposits were combined in a disposal cell on the original millsite. NRC concurred that this disposal cell conformed to EPA standards, and the surface improvements were brought under the general license in 1997. NRC fully licensed the site in 1998 after concurring with DOE's ground water monitoring plan. The cell top is grass covered and is mowed each year to discourage growth of deep-rooted plants on the cover. Vegetation on the riprap-armored side slopes is controlled by cutting and application of herbicides. The ground water is sampled to monitor cell performance and to ensure that users are not exposed to legacy processing-related ground water contamination.

Grand Junction, Colorado, Disposal Site

Low-level radioactive material from the Grand Junction, Colorado, area was placed in a disposal cell located approximately 12 miles south of Grand Junction. A portion of the cell will remain open until as late as 2023 under the Long-Term Radon Management Project to receive additional radioactive material. The LTSM Program assumed responsibility for the entire site in 1998, but the provisions of the site long-term surveillance plan address only the closed portions of the cell. Ground water monitoring has not detected any seepage from the cell. DOE continues to control the encroachment of deep-rooted plants on the rock-armored cell cover through cutting and treatment with herbicides.

Grand Junction, Colorado, Processing Site

Uranium mill tailings and associated ore-processing wastes were removed from the former millsite located along the Colorado River in Grand Junction and transported to the Grand Junction Disposal Site. The processing site was also the staging location for uranium mill tailings-contaminated material removed from more than 4,000 vicinity properties in the Grand Junction area. DOE transferred the site to the LTSM Program in 2002. The uppermost aquifer is of limited use because of naturally occurring uranium and selenium and contamination from former ore-processing activities. The contaminated ground water is managed through application of supplemental standards, institutional controls, and monitoring to ensure the protection of human health and the environment. In 2002, DOE decommissioned 34 unneeded monitor wells associated with this site.

DOE decommissioned 34 monitor wells at the Grand Junction, Colorado, Processing Site.

Green River, Utah

Tailings, contaminated soil, and building debris were encapsulated in an on-site disposal cell in 1989. NRC accepted the Green River Disposal Site under the general license for UMTRCA Title I sites in 1998, and the site was transferred to the LTSM Program. In addition to annual inspections, ground water is monitored to evaluate cell performance, trends of contaminant levels, and the relationship between local precipitation and ground water flow. The underlying aquifer contains naturally elevated levels of selenium and is not used as a drinking water source; however, the aquifer was also locally contaminated by former uranium ore-processing operations at the site. The Uranium Mill Tailings Remedial Action (UMTRA) Ground Water Project, managed by the DOE Grand Junction Office, is characterizing site ground water to develop a compliance strategy.

Gunnison, Colorado

Uranium mill tailings and contaminated material from demolished mill structures formerly located near the Gunnison River and from vicinity properties in Gunnison were relocated to the Gunnison Disposal Cell in 1995. NRC licensed the site in 1997. Ground water monitoring is required at six point-of-compliance wells; analytical results continue to confirm that the cell is performing as designed. Riprap durability is monitored at key locations around the base of the cell because of freeze–thaw conditions; no degradation of the riprap is evident. DOE monitors the expansion of an adjacent county landfill to ensure that no activities adversely affect the disposal site.

Lakeview, Oregon

Remedial action was completed at the Lakeview Disposal Site in 1989, and NRC placed the site under the DOE general license in 1995. The disposal cell side slopes are armored with riprap, and the top slope is covered with riprap, overlain with soil, and planted with native grasses. The riprap is monitored annually for signs of accelerated weathering and consequent reduction in size. The LTSM Program monitors site ground water once every 5 years to verify that contaminants are not leaching from the disposal cell. DOE is continuing to investigate the effects of deep-rooted plants on the permeability of the cell cover.

Lowman, Idaho

In 1992, DOE consolidated radioactive material from processing operations and from vicinity properties onto existing radioactive sand piles and encapsulated the material beneath an engineered cell cover. NRC licensed the disposal site in 1994. Ground water monitoring is required to confirm cell performance. On the basis of analysis of the ground water quality and the chemistry of the encapsulated material, DOE will request concurrence from NRC to discontinue monitoring the ground water. Encroachment of vegetation on the cell, which allows surface water to infiltrate the cell, is no longer controlled because the encapsulated material generally is insoluble and resistant to leaching. Therefore, the natural plant community succession can be allowed to proceed without increased risk to the public health or the environment. As a best management practice, the LTSM Program will cut large trees to prevent damage that would occur to the cell cover if the trees were blown down and their root systems were unearthed.

Maybell, Colorado

Tailings and process-related waste were consolidated on the existing tailings pile and were encapsulated in 1998. NRC concurred that remediation was complete and accepted the site under the general license in 1999. The site lies in a former uranium-mining district and several abandoned mines and remediated processing sites are located nearby. Local ground water was contaminated by uranium mineralization and from mining activities and, therefore, is not monitored for compliance. In 2002, DOE decommissioned 18 unneeded monitor wells at this site. Because a large quantity of moist material was encapsulated in a portion of the cell, settlement plates installed on top of the cell are surveyed annually to detect potential differential settlement. No significant settlement has occurred.

Mexican Hat, Utah

The Mexican Hat Disposal Cell contains mill tailings and waste from former uranium ore-processing facilities at Mexican Hat, Utah, and Monument Valley, Arizona. NRC accepted the Mexican Hat Disposal Site under general license in 1997, and subsequently the site was transferred to the LTSM Program. The Navajo Nation retains title to the land. Processing operations at the site did not affect the ground water in the uppermost aquifer; however, water containing processing-related contaminants remains in shallow perched zones at this site. The perched zones are recharged by local precipitation and are not used as a water supply. DOE reduced seep monitoring in 2002 with the concurrence of the Navajo Nation. Seep monitoring had been conducted on a quarterly basis as a best management practice but was reduced to an annual basis as required by the long-term surveillance plan to monitor cell performance. The reduction in frequency was based on DOE's analysis that the minor amounts of contaminated water that emerge from local seeps do not pose unacceptable human health or ecological risk associated with exposure to the seep water. A severe rainstorm in September 2002 caused erosional damage to a drainage ditch and several site improvements but not to the cell; the LTSM Program repaired the damage in December.

Naturita, Colorado

Contaminated soil and building debris from a uranium ore-processing site adjacent to the San Miguel River were relocated to a sandstone quarry near the UMETCO Title II site at Uravan, Colorado, and were encapsulated beneath an engineered cover. NRC licensed the Naturita Disposal Site in 1999. Laboratory analyses of ground water samples from shallow water-bearing formations confirm that the cell is performing as designed. A standpipe used for water-level monitoring to determine if water was accumulating in the cell was decommissioned in 2002 because of a continuous decline in the water level. Successful revegetation of areas disturbed during construction of the cell allowed closure of the storm water discharge permit in 2002.

Rifle, Colorado

In 1996, DOE relocated wastes from two former uranium and vanadium ore-processing sites near the Colorado River and waste from decontaminated vicinity properties to the Rifle Disposal Cell located north of Rifle. NRC accepted the disposal site under the general license for custody and long-term care in 1998. Two wells installed in the deepest part of the cell have been used by the LTSM Program to monitor water accumulating in the bottom of the disposal cell since construction was completed in 1996. To prevent this water from rising high enough to saturate the cell embankment, DOE began pumping water to an evaporation pond that was constructed in 2001. DOE installed a new fence and gate in 2002 to limit access to the site and to prevent potential vandalism to the cell dewatering pumping system and evaporation pond (see inset photo on report cover).

Salt Lake City, Utah, Disposal Site

Mill tailings and associated contaminated material were relocated from the Salt Lake City Processing Site to this disposal cell in 1988. The disposal site, located about 80 miles west of Salt Lake City, is adjacent to a commercial low-level radiological waste disposal facility. NRC licensed the disposal site in 1997. The existing ground water is classified as limited use because of its naturally poor quality; therefore, ground water monitoring is not required. DOE worked with the operator of the waste facility to realign the access route to the disposal cell to accommodate on-going haul and disposal operations surrounding the DOE property.

Salt Lake City, Utah, Processing Site

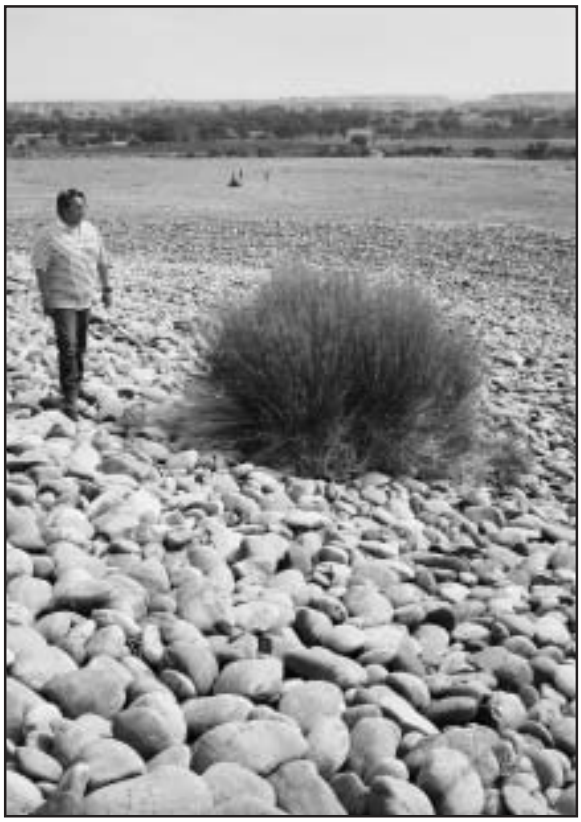
The State of Utah completed remedial action of this former uranium and vanadium ore-processing site in 1987 under the direction of the DOE UMTRA Project. In 2000, NRC concurred with the ground water compliance strategy for the site, and DOE transferred site responsibility to the LTSM Program. Contaminated ground water and small pockets of contaminated soil remain at this location. Ground water in the uppermost aquifer is not a current or potential source of drinking water because of naturally poor water quality and because the processing-related contamination cannot readily be cleaned up using conventional methods. The soil contamination does not pose an unacceptable risk to public health or the environment. Ground water compliance and control of the contaminated soil are achieved through application of supplemental standards and institutional controls. The LTSM Program will monitor ground water and surface water at this location until at least 2004 and will continue to monitor institutional controls on an annual basis (see sidebar).

Institutional Controls

Most of the sites assigned to the LTSM Program for long-term stewardship cannot be released for unrestricted use because regulated materials remain on site at the completion of remedial action. Disposal cells must be protected from damage by surrounding development or construction activities, and residual contamination remaining in the soil or ground water must be controlled to protect public health and the environment.

DOE establishes nonengineering measures referred to as institutional controls to prevent or limit exposure to hazardous substances left in place at a site or to ensure effectiveness of the remedy. Typically, institutional controls depend on some legal order such as zoning ordinances or restrictions placed on the use of land, ground water, or surface water. Key to identifying, implementing, and enforcing institutional controls is participation by local and state governments in the development process.

The need for, and the duration of, institutional controls depends on the compliance strategy selected for a site, the type and level of risk to humans and the environment, and existing site conditions. As risks decrease over time, such as when contaminated ground water undergoes passive remediation through natural flushing, the need for institutional controls might also decrease. Conversely, monitoring might indicate that the institutional controls implemented for a site are not sufficient to fully control exposure to contaminated materials. It is important, therefore, that institutional controls be evaluated for their effectiveness and modified as necessary to ensure continued protection of public health and the environment.



Vegetation growth on a cell side slope is checked during the inspection of the Shiprock, New Mexico, Disposal Site.

Shiprock, New Mexico

Cleanup of the former Shiprock uranium ore-processing site was completed in November 1986 by consolidating and stabilizing mill tailings in an on-site engineered disposal cell. NRC licensed the Shiprock Disposal Site in 1996. The Navajo Nation retains title to the land. Annual maintenance activities include controlling deep-rooted weeds and tamarisk, a noxious shrub, through cutting and application of herbicides. The UMTRA Ground Water Project is characterizing ground water contaminated by former processing operations; however, the aquifer is not monitored by the LTSM Program because of its low yield and naturally poor water quality. Runoff from severe storm events in 2001 and 2002 damaged a drainage channel and several site improvements, but the integrity of the cell was not affected. Temporary repairs were completed in 2002.

Slick Rock, Colorado

Tailings from two former uranium ore-processing sites adjacent to the Dolores River were relocated to the Slick Rock Disposal Cell in 1996. This disposal site was accepted under the NRC general license in 1998 and was transferred to the LTSM Program. The cell contains tailings, contaminated debris, and soil from the demolished mill structures and vicinity properties. The riprap-armored cell is sited on a small mesa on unsaturated sedimentary rock. No ground water monitoring is required at the disposal cell location.

In 2002, DOE decommissioned two standpipes that had been used to monitor water levels in the cell because water levels were continuously below the datum specified in the long-term surveillance plan.

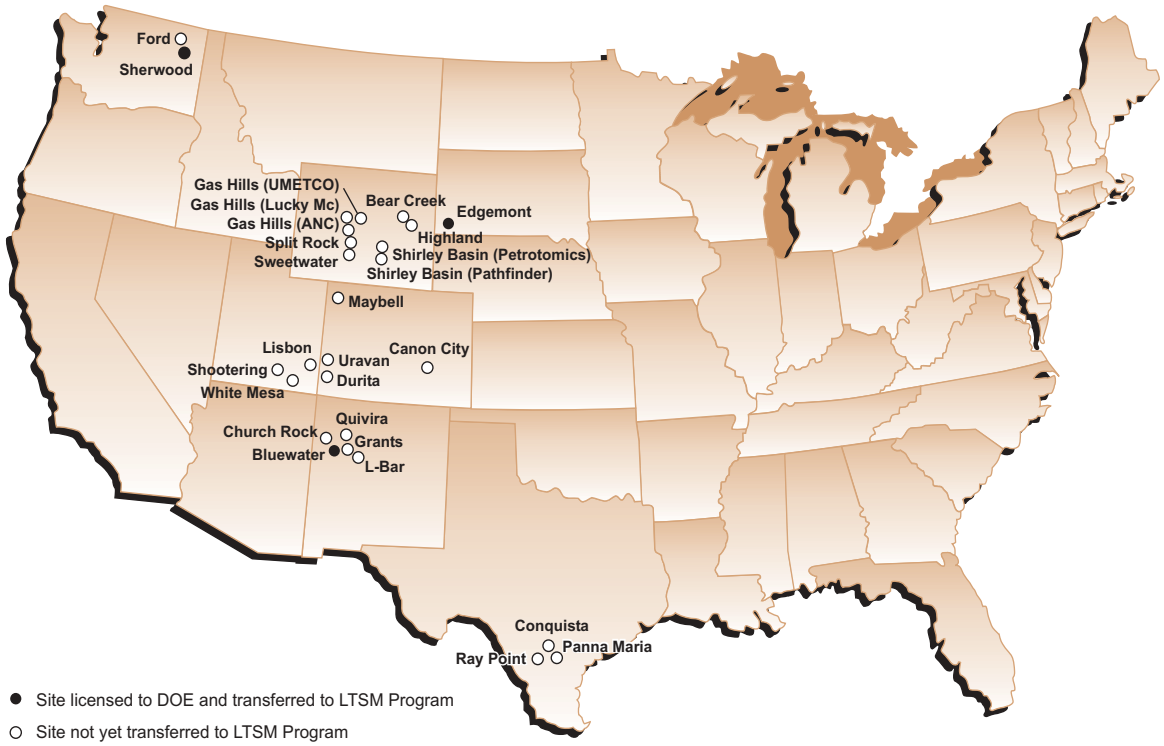
Spook, Wyoming

This site consisted of a small open-pit uranium mine, ore piles, mine adits, ore-processing structures, and associated tailings. DOE placed all contaminated material in the pit on a low-permeability soil layer and constructed an engineered cover over the waste. Under the Surface Mining Control and Reclamation Act, stockpiled overburden was compacted up to 60 feet thick over the encapsulated material. The surface was graded to provide drainage away from the site and to match surrounding topography. Because of the successful site grading and revegetation efforts, only the site markers and perimeter signs distinguish the site from the surrounding land. Ground water monitoring is not required because the existing ground water contains widespread and naturally occurring dissolved uranium and is classified as limited use.

Tuba City, Arizona

DOE encapsulated mill tailings in place over the existing tailings pile at this site in 1990. NRC granted DOE a general license for custody and long-term care of the surface impoundment at the Tuba City Disposal Site in 1996, and the site was transferred to the LTSM Program. The Navajo Nation retains title to the land. Accumulation of blowing sand and associated minor volunteer vegetation growth on the rock cover continues to be studied to assess if the plants are affecting the water-barrier properties of the cover system. Until the study is completed, maintenance activities include cutting deep-rooted plants and treating them with herbicides. Ground water quality is monitored by the LTSM Program at seven monitor wells. The UMTRA Ground Water Project began active ground water remediation at the site in 2000.

Site marker at the Slick Rock, Colorado, Disposal Site.



Locations of UMTRCA Title II Sites

UMTRCA Title II Disposal Sites

Uranium processing sites addressed by Title II of UMTRCA were active when the act was passed in 1978. These sites were commercially owned and are regulated under NRC license. For license termination, the owner must conduct an NRC-approved reclamation of any on-site radioactive waste remaining from former uranium ore-processing operations. The site owner also must ensure full funding for inspections and, if necessary, ongoing maintenance. DOE then accepts title to these sites for custody and care. DOE administers the sites under the provisions of a general NRC license granted under 10 CFR 40.28, "General License for Custody and Long-Term Care of Uranium or Thorium Byproduct Materials Disposal Sites."

The LTSM Program manages 3 UMTRCA Title II sites (see page 37); this number is expected to increase to 20 sites by 2006 as ongoing site reclamations are completed. Ultimately, as many as 27 UMTRCA Title II sites may be managed by the LTSM Program (3 additional Title II sites are scheduled for transfer to the LTSM Program in 2003; see sidebar). A summary of the status of each UMTRCA Title II site managed by the LTSM Program is presented in this report; complete annual reports and fact sheets are available on the LTSM Program website at **http://www.gjo.doe.gov/programs/ltsm** or from the LTSM Program office at the DOE Grand Junction Office.

Bluewater, New Mexico

ARCO Coal Company stabilized mill tailings piles in place and completed engineered covers in 1995 at this site. NRC accepted the site under the general license in 1997. The radon barrier covering the wastes is protected by riprap. The Bluewater site incorporates

other stabilized disposal areas, including a small riprap-armored disposal cell containing polychlorinated biphenyl (PCB)-contaminated byproduct material that was permitted by the U.S. Environmental Protection Agency (EPA) and is in compliance with the Toxic Substances Control Act. Several years of active ground water treatment did not succeed in lowering ground water contaminant levels to background concentrations. Subsequently, NRC granted alternate concentration limits for the site. DOE conducts ground water monitoring at the Bluewater site to verify continued compliance with the approved limits. The presence of PCBs was not detected in 2002 samples, and concentrations of the process-related contaminants of concern were within approved limits.

Edgemont, South Dakota

The Tennessee Valley Authority relocated tailings from the millsite to an engineered disposal cell in 1989. Material from Edgemont vicinity properties, which were remediated by the UMTRA Project, was co-located in the disposal cell with material from the millsite. NRC concurred with placing this disposal site under the general license for long-term custody in 1996. Ground water monitoring is not required for this site because the uppermost confined aquifer lies below an impermeable bedrock layer. The top of the cell has a grass cover and is managed by controlled livestock grazing to promote the long-term health of the turf.

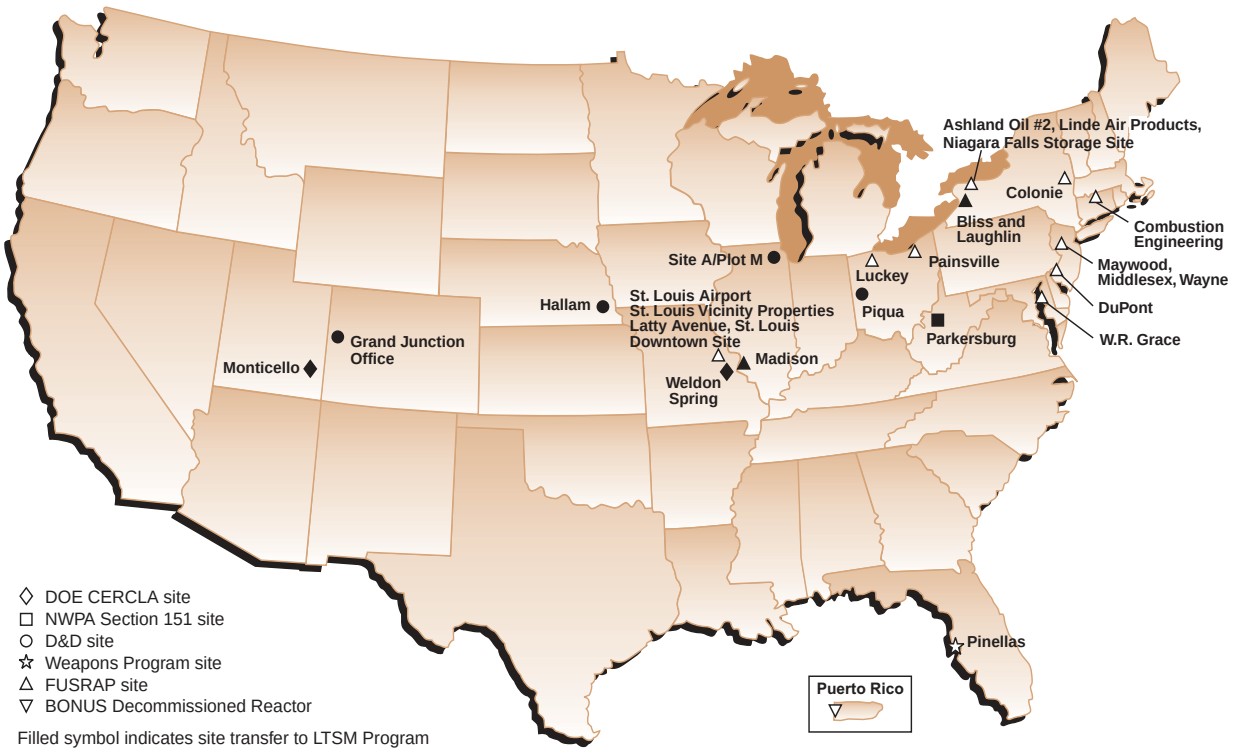
Sherwood, Washington

The Sherwood Disposal Site is situated on the Spokane Indian Reservation. Uranium ore was mined and milled at this site from 1978 to 1984. Western Nuclear, Inc., completed encapsulating the tailings in an engineered disposal cell in 1996, and NRC included the site under general license in 2001. Native plant species were established on the soil cover. The encapsulated waste remains saturated by design to prevent metals in the waste from chemically altering to forms that might leach into the underlying bedrock. Ground water sampling and analyses are conducted in accordance with the site-specific long-term surveillance plan; 2002 sampling results show that all measured parameters are within acceptable ranges. The impoundment face of the cell has been classified as a dam, requiring safety inspections to ensure compliance with the Federal Dam Safety Act.

Transfer Nearly Complete for Three Title II Sites

Three UMTRCA Title II sites are expected to be transferred to the LTSM Program in 2003: the former Petrotomics (Shirley Basin South) and Union Pacific (Bear Creek) sites in Wyoming and the former Sohio Western (L-Bar) site in New Mexico. In all three cases, NRC has approved the completion of surface reclamation and has granted alternate concentration limits as the ground water compliance strategy. DOE is currently working with NRC, state regulatory agencies, and licensees to resolve outstanding issues necessary to complete the final site transfers to DOE for long-term stewardship.

Issues that require resolution prior to transfer of these sites to the LTSM Program include establishing permanent legal site access (Bear Creek), determining ownership and transfer of mineral rights (Bear Creek), estimating the fate of a ground water contaminant plume (Shirley Basin South), and resolving issues related to a pre-existing ground water discharge permit (L-Bar). Resolution of these and other stewardship-related issues and requirements, which will be worked out among DOE, NRC, EPA, state agencies, tribes, landowners, and others, is typical of the process involved in site transfer.



Locations of Non-UMTRCA Sites

NWPA Section 151 Site

Certain sites with low-level radioactive contamination remediated by the owner under the NRC Site Decommissioning Management Program can be transferred to the Federal Government under Section 151 of the Nuclear Waste Policy Act (NWPA). NRC will terminate the site license only after concurring with the implemented remedial action, determining that the owner has obtained approval of the long-term steward to accept responsibility for the site, and ensuring future funding for long-term stewardship. Only one NWPA Section 151 site, located at Parkersburg, West Virginia, has been transferred to DOE and is managed by the LTSM Program.

Parkersburg, West Virginia

Radioactive zirconium ore was processed at this site under contract to U.S. Atomic Energy Commission (AEC) from 1957 to 1968, resulting in waste accumulation and soil contamination. Remediation of the site was completed in 1982 when the NRC-approved disposal cell was closed. The grass-covered disposal cell covers an area of approximately 12 acres, and the 15-acre site is surrounded by a posted security fence. Custodial maintenance for the Parkersburg site includes mowing to discourage the establishment of shrubs or trees that may degrade the cover. The LTSM Program initiated annual inspections at this location in 1994. Site ground water quality, which is monitored by DOE at 5-year intervals, complies with the Federal Safe Drinking Water Act and State of West Virginia ground water standards.

CERCLA Sites

DOE was identified as the lead agency for cleanup of three sites that the U.S. Environmental Protection Agency (EPA) placed on the National Priorities List. Uranium contamination remained from federal milling and processing operations at these locations. The sites were remediated in accordance with Comprehensive Environmental Response,

Compensation, and Liability Act (CERCLA) regulations. Because these sites cannot be released for unrestricted use, DOE is required by statute to conduct 5-year remedy performance reviews.

In 2001, the LTSM Program assumed responsibility for two remediated National Priorities List sites at Monticello, Utah. Transfer of the Weldon Spring, Missouri, National Priorities List site to the LTSM Program for long-term stewardship occurred in 2002.

Monticello, Utah, Sites

EPA listed the Monticello, Utah, Mill Tailings Site and the Monticello Radioactively Contaminated Properties Site (also known as the Monticello Vicinity Properties Site) on the National Priorities List in 1986. Monticello mill activities generated approximately 2.5 million cubic yards of low-level radioactive waste as a result of uranium- and vanadium-ore processing. Contaminated material was distributed by wind and water and limited amounts were used for construction, resulting in contamination of more than 400 vicinity properties. These properties and the millsite were cleaned up and the material was placed in a disposal cell on DOE-owned property south of the former millsite. Construction of the disposal cell was completed in 2000 (see page 37).

EPA deleted the Monticello Radioactively Contaminated Properties Site from the National Priorities List in 2000. DOE is pursuing partial deletion of portions of the Monticello Mill Tailings Site.

In June 2000, DOE transferred the former uranium mill tailings site and adjacent government-owned properties to the City of Monticello, Utah, through the Federal Land-to-Parks Program. The city is responsible for restoration of the former millsite and is developing the property for public recreation.

Supplemental standards were applied to limited occurrences of radioactive material that was left in place because the material posed no risks and remediation would be technically unfeasible, unjustifiably expensive, or harmful to the environment. The supplemental standards areas include subgrade portions of streets and buried utilities.

In 2001, these sites transitioned into stewardship status and were assigned to the LTSM Program for long-term care and custody. Transition activities included identifying and cataloging stewardship records, documenting baseline conditions for such features as recently revegetated areas and surface conditions at supplemental standards properties, and reviewing institutional controls and associated legal recordings and maintenance activities.

Annual inspections of the sites and supplemental standards areas, which DOE will conduct in perpetuity, were initiated in 2001. The first postclosure 5-year review reports, incorporating information from the 2001 inspections, were issued for the Monticello Mill Tailings Site and the Monticello Radioactively Contaminated Properties Site in June 2002.

Two LTSM Program personnel are assigned to the Monticello site to monitor and maintain disposal cell systems and arrange for disposal of mill tailings encountered during construction activities in supplemental standards areas. Major activities conducted in 2002 included extending a rock-lined drainage channel that carries storm water from the disposal cell to a natural drainage channel and installing a fence around land containing supplemental standards areas that was transferred by DOE to the City of Monticello (see inset photo on report cover).

Weldon Spring, Missouri

The Federal Government operated the Weldon Spring Uranium Feed Materials Plant (referred to as the chemical plant) between 1955 and 1966 on a site previously used by the U.S. Army to manufacture explosives. Operations consisted of purifying uranium oxide and other concentrates into uranium metal or into feedstock for enrichment operations at other locations. Both the U.S. Army and DOE disposed of waste materials in a nearby quarry.

DOE began remediation of the site in 1986. Remedies were selected and remediation has been completed at three of four designated operable units. Contaminated soil and debris from remedial action activities were encapsulated in a disposal cell at the former chemical plant site (see page 37). Selection of the remedy for the Ground Water Operable Unit, involving remediation of contaminated ground water associated with the chemical plant site, is expected in 2003. Institutional controls for managing areas with contamination left in place and to complete CERCLA closeout documentation are being developed and are expected to be ready for implementation in 2003.

The Weldon Spring Site was transferred to the LTSM Program in October 2002. Transition activities initiated in 2002 included releasing a draft long-term stewardship plan for stakeholder comment and conducting public work sessions to obtain community input on stewardship requirements and protocols. Stewardship requirements will include conducting annual site inspections; performing CERCLA 5-year reviews; maintaining the cell leachate collection system; monitoring ground water, surface water, and institutional controls; and continuing community relations and awareness activities.

D&D Sites

The LTSM Program currently manages four DOE Defense Decontamination and Decommissioning (D&D) Program sites: Piqua, Ohio; Hallam, Nebraska; Site A/Plot M located near Chicago, Illinois; and the DOE Grand Junction Office facility in Grand Junction, Colorado. The first three sites were transferred from the custody of the DOE Chicago Operations Office in 1998. The Grand Junction Office facility was transferred to the LTSM Program in 2001.

DOE began transition activities for the decommissioned Boiling Nuclear Superheating (BONUS) research reactor in 2002 and will transfer the site to the LTSM Program in 2003. DOE will manage this facility as a fifth D&D site because the U.S. Atomic Energy Commission (AEC) constructed the reactor under a program similar to the one used for the Piqua and Hallam reactors.

Piqua, Ohio, and Hallam, Nebraska

The Piqua and Hallam sites are former nuclear reactor facilities that were built for the AEC Power Demonstration Program during the mid-1960s. In both cases, the reactors were operated in cooperation with, and on the property of, local electric utilities. Both reactors were decommissioned in the late 1960s and, after removal of fuel assemblies and removable contamination, the reactor vessels were sealed with concrete and steel. Annual inspections and monitoring are conducted by the LTSM Program to verify encapsulation integrity.

Site A/Plot M, Illinois

The Site A/Plot M area is the former location of Argonne National Laboratory and its predecessor, the University of Chicago Metallurgical Laboratory. Site A contains buried contaminated building debris and the biological shield for Enrico Fermi's CP–2 and CP–3 reactors. Plot M contains buried radioactive waste that was generated from the mid-1940s to 1949. Site A/Plot M was decommissioned in 1956. The LTSM Program is responsible for environmental monitoring of this area.

Grand Junction Office Facility, Colorado

The DOE Grand Junction Office was established by the Manhattan Project to purchase uranium ore concentrates. DOE conducted pilot uranium ore-milling studies at the site between 1953 and 1958. Contaminated soils from the pilot milling operations were removed except for deposits under portions of two buildings; this contamination will be remediated when DOE vacates the buildings. All the other buildings that were contaminated during site milling operations were decontaminated or demolished. Contaminated water remains in the underlying alluvial aquifer, two ponds, and wetlands on the site and is being remediated through natural flushing of the aquifer. Ground water and

surface water quality is expected to meet standards by 2080. The Grand Junction Office site was transferred to the LTSM Program for stewardship in 2001. Institutional controls and water-quality monitoring will be necessary until all remediation is completed.

BONUS, Puerto Rico

The BONUS research reactor operated at Rincón, Puerto Rico, from 1962 until 1967. Decommissioning was completed by 1970. The reactor was defueled and the radioactive pressure vessel and internal components were entombed in place. DOE is responsible for the radioactive material at the site; the Puerto Rico Electric Power Authority owns the land and improvements. Stewardship requirements include inspections, radiological monitoring, records management, and community relations. Site transition activities by the LTSM Program commenced in 2002, including a review of the 2002 radiological survey report for the decommissioned reactor to become familiar with the radiological conditions of the site.

Long-Term Radon Management Project

Radioactive material from the Grand Junction, Colorado, Processing Site and mill tailings and tailings-contaminated material from more than 4,000 Grand Junction vicinity properties were relocated to the UMTRCA Title I Grand Junction Disposal Site under the DOE UMTRA Project. Contaminated material from the Grand Junction Office Remedial Action Project at the DOE Grand Junction Office site was co-located with the UMTRCA waste. The 360-acre disposal site is located 12 miles south of Grand Junction in Mesa County, Colorado. A 60-acre disposal cell was constructed on the site to contain 4,600,000 cubic yards of low-level radioactive material.

A portion of the cell was left open to accept as much as 250,000 cubic yards of tailings from Grand Junction vicinity properties, other UMTRCA locations, and the Monticello, Utah, CERCLA sites. This action was taken to provide a disposal location for incidental low-level radioactive material, such as might be removed from utility trenches and from beneath streets as those structures are rebuilt. The cell will not remain open past 2023. In 2002, the Grand Junction Office LTSM Program provided long-term care for the facility and operated the cell for disposal activities in April and May.

Approximately 5,150 cubic yards of tailings were disposed of in the cell in 2002. Most of the material was hauled from the City of Grand Junction interim repository. The remaining quantity consisted of two loads from local private contractors; three loads from Monticello, Utah; and approved waste material from the DOE Grand Junction Office site.

FUSRAP Sites

DOE established the Formerly Utilized Sites Remedial Action Program (FUSRAP) in 1974 to remediate sites where radioactive contamination remained from Manhattan Project and early AEC operations. DOE assessed more than 500 candidate facilities and determined that 46 sites required remediation. DOE remediated 25 sites by 1998; thereafter, the U.S. Congress directed the U.S. Army Corps of Engineers to remediate the remaining 21 designated FUSRAP sites. Remediation of FUSRAP sites is in accordance with CERCLA protocols.

In 1999, DOE negotiated a Memorandum of Understanding with the U.S. Army Corps of Engineers to transfer responsibility for FUSRAP sites to DOE for long-term care 2 years after remedial action has been completed. Remediated sites will become the responsibility of the LTSM Program.

LTSM Program personnel worked with DOE Headquarters, DOE Idaho Operations Office, and the U.S. Army Corps of Engineers to establish an effective and efficient transition process. The transition process was used to transfer responsibility for two remediated sites to DOE. Those sites, located at Madison, Illinois, and at the Bliss and Laughlin facility in Buffalo, New York, were released for

unrestricted use. Consequently, stewardship responsibilities consist of managing records and responding to requests for information. The initial 25 sites remediated by DOE also were released for unrestricted use. LTSM Program personnel are currently coordinating transfer of records for those sites to program archives.

Cover Monitoring and Long-Term Performance Project

Scientists and engineers with the Cover Monitoring and Long-Term Performance Project participate in many research initiatives to study disposal techniques, impoundment designs, and disposal cell cover-performance evaluation methods. LTSM Program sites provide case studies of the performance of existing designs. Evolving design guidance will incorporate the results of investigations into future contaminant-isolation systems constructed by DOE and other government and private entities.

LTSM Program scientists also investigate issues of immediate interest to the LTSM Program, including the effect of vegetation on disposal cell cover performance, water movement within disposal cells, and slope stability and erosion control. Stewardship research into naturally occurring processes that will influence the performance of containment and closure systems must continue for many years before conclusive results are evident. Significant results have already been reached in some areas of research, as indicated by the publications and presentations described in "LTSM Program Accomplishments," page 14.

Consortia of investigators from many agencies and institutions are working together on stewardship research managed by the DOE Grand Junction Office. In 2002, LTSM Program researchers teamed with U.S. Environmental Protection Agency (EPA) Region 8 Federal Facilities Program, EPA Alternative Cover Assessment Program, DOE Office of Science and Technology, Sandia National Laboratories, Pacific Northwest National Laboratory, Savannah River Technology Center, Desert Research Institute, University of Arizona, Washington State University, Florida State University, and Central European Advanced Technologies to study the design and long-term performance of engineered covers and applications of phytotechnologies. The following sections present highlights of specific projects. More information is available on the LTSM Program website at **http://www.gjo.doe.gov/programs/ltsm**.

Monticello, Utah, Cover Performance Monitoring

In 2002, LTSM Program scientists and engineers continued participation in the Alternative Cover Assessment Project funded by the EPA National Risk Management Research Laboratory. The goal of this project is to develop new guidance for cheaper, more effective covers for municipal and hazardous waste landfills in arid and semiarid western states, sites currently regulated under Subtitle C or D of the Resource Conservation and Recovery Act (RCRA). Researchers use field studies and modeling to acquire data needed to evaluate alternative covers. The Monticello, Utah, Disposal Cell cover includes a thick soil layer, a capillary barrier, and a diverse plant community designed to remove rainwater and snowmelt by evapotranspiration and, thereby, limit water flux into the tailings.

In 2000, a team of scientists and engineers from the EPA National Risk Management Research Laboratory, Pacific Northwest National Laboratory, Desert Research Institute, and the LTSM Program installed instrumentation and data telemetry to begin monitoring the performance of a 3-hectare facet of the Monticello Disposal Cell cover, creating one of the largest water-balance lysimeters in the world. The instrumentation includes three nests of sensors for monitoring soil-water content and soil-water potential, one dosing basin for monitoring drainage from the capillary barrier for the entire 3-hectare facet, and a second dosing basin for monitoring runoff from a 200-square-meter surface-runoff test plot.

In 2002, LTSM Program and Desert Research Institute scientists monitored the water balance and plant ecology of the lysimeter. The measured flux rate was well below the EPA standard and occurred during a period when annual precipitation was well below average and the diversity and abundance of vegetation on the disposal cell cover was much less than revegetation goals.

Natural and Archaeological Analogs of the Long-Term Performance of Engineered Covers

Engineered cover systems are needed that will limit risks to public health and the environment from encapsulated contaminants for hundreds to thousands of years. This is an unprecedented engineering challenge. To compound the issue, current design approaches fail to take into consideration the influences that the inevitable long-term changes in the environmental setting may have on the cover and the encapsulated material.

In 2002, the LTSM Program continued collaboration with the DOE Headquarters Office of Science and Technology, Desert Research Institute, and Washington State University on a demonstration of methods derived from the natural sciences for incorporating long-term environmental change in the engineering design process. The demonstration involves the characterization of natural analogs (locations with natural soils similar to the cover materials) that represent likely long-term changes in the climate, soil hydrology, and ecology of an engineered cover.

Evaluations of natural and archaeological analogs of climate change, soil development, and ecological change at the Monticello, Utah, CERCLA site were initiated. Reasonable ranges of long-term climate change for Monticello were proposed based on a review of patterns of change and extremes in meteorological records, magnitudes of relevant past climate states, and projected states from climate change models. Existing geographic locations were selected that are analogous to possible future climate states at Monticello.

The morphology and hydrology of natural and archaeological soils were characterized in soil pits excavated at wet/cold and warm/dry climate analog sites. The physical properties of these soils were otherwise similar to the engineered soil used to construct the disposal cell cover at Monticello. Characterization of plant ecology, plant ecophysiology, and animal habitat also commenced during 2002 at the climate analog sites.

Lysimeter Studies of Evapotranspiration Cover Designs

The LTSM Program continued to collaborate with EPA Region 8 at the Monticello, Utah, Lysimeter Test Facility on studies of alternative engineered cover designs. The alternative designs depart from conventional Uranium Mill Tailings Radiation Control Act and RCRA designs because they rely on (1) a thick topsoil layer and a capillary barrier to retain precipitation and (2) soil evaporation and plant transpiration (evapotranspiration) to dry the topsoil seasonally and to limit water movement into the encapsulated tailings. Two studies are ongoing with small weighing lysimeters and large drainage lysimeters.

The small weighing lysimeters consist of 30-centimeter-diameter tubes filled with model cover systems. The study compares alternative cover designs with soil layers consisting of different soil types and layer thicknesses overlying capillary barriers, including a design matching the cover installed on the Monticello, Utah, Disposal Cell. The small lysimeters can be weighed, drained of free liquid, and then weighed again to monitor the drainage, water storage, and evapotranspiration of the various cover designs. For all models (soil types and layer thicknesses), the drainage rate in the small lysimeters has been well below the EPA standard. The mean drainage for all treatments declined between 1995 and 1999, and drainage was undetected in all treatments in 2000 through 2002. The steady decline in drainage during the monitoring period can be attributed to plant root development and an increase in evapotranspiration.

The large drainage lysimeters consist of caissons buried in the ground. A full-scale vertical profile of the Monticello Disposal Cell cover was constructed in one caisson in 1998, incorporating the most suitable materials available at the site. Instrumentation for automated monitoring of the soil-water balance is accessed in an adjacent caisson. In fall 1999, a second full-depth cover profile was constructed at the facility incorporating actual cover materials from stockpiles. Both cover profiles were constructed with water content reflectometers installed at regular intervals to evaluate water storage changes, tipping bucket gauges to monitor drainage, and clear tubes for borehole cameras to monitor root depth and abundance. The output from these devices and other monitoring instruments, including meteorological observations, is collected continuously and downloaded on command from a remote location. Annual drainage rates for both lysimeters remain well below the EPA standard.

An LTSM Program scientist measures plant cover on the large caisson lysimeters at Monticello, Utah, using an ocular point-intercept method.

Moab, Utah, Alternative Cover Investigation

In 2002, LTSM Program scientists began collaboration with EPA Region 8 on a field evaluation of the water storage capacity of potential soil sources for an evapotranspiration cover for a disposal cell for contaminated material at the former uranium ore-processing site near Moab, Utah. The study is being conducted at the Monticello, Utah, Lysimeter Test Facility. For this investigation, water storage capacity is measured as the difference between the amount of water retained in soil after excess water has drained away and the amount of water remaining when the soil dries to the permanent wilting point (the lower limit of extraction by plants). Three different soil types are being studied by ponding water in the lysimeters until the soil profile is saturated and water is draining from the lysimeters. The lysimeters are weighed and drained regularly to determine the soil water storage at the point drainage stops.

Moab, Utah, Technologies for Evaluating Plant Health and Phytoremediation

LTSM Program scientists teamed with the DOE Office of Science and Technology, DOE Savannah River Technology Center, Central European Advanced Technologies, and Florida State University in 2002 on a demonstration of methods for monitoring and evaluating the health of plants used for phytoremediation applications. The demonstration was conducted using tamarisk growing in contaminated ground water at the former uranium ore-processing facility near Moab, Utah.

Several indices of plant health were measured in tamarisk stands growing in areas with both high and low ammonia concentrations in ground water. Results suggest that rates of passive phytoremediation are likely much lower than the potential for tamarisk at the Moab site. Factors other than toxic levels of ammonia in ground water, such as depth to ground water, salinity, and elevated levels of other contaminants, may contribute to poor tamarisk health.

A map of tamarisk water use was developed based on a combination of plant health results, data in water-use literature, and a single false-color infrared satellite image of the study area. The map provided a first approximation of transpiration rates for input to site water-balance modeling.

Lakeview, Oregon, Cover Performance Investigation

Observations during routine inspections of the riprap-armored side slopes and woody plant encroachment on the soil-covered top slope of the Lakeview, Oregon, Disposal Cell led to an evaluation of cover performance by LTSM Program scientists. Annual monitoring has shown that the average rock size has been decreasing and could decrease to below the original design specification for erosion control. Revised erosion calculations, however, indicate that smaller rock provides adequate erosion protection. Furthermore, evaluations of natural analog slopes may indicate that rock is unnecessary for long-term stability.

Measurements show that the permeability of the cover where woody plants have established exceeds the design specification and is highly variable. Further evaluations revealed that water moves through small fractures in the compacted soil layer in the cover that are artifacts of the natural structure of the borrow soils. However, the results of a vegetation analog study suggest that over time an increase in plant abundance on the cover and associated increases in evapotranspiration could help to offset infiltration. In 2003, LTSM Program scientists plan to model the hydrologic performance of the disposal cell for a range of existing and possible future conditions.

Lowman, Idaho, Sand Leaching Evaluation

Roots of ponderosa pine trees that established on the Lowman, Idaho, Disposal Cell have penetrated into the cover at this site. The LTSM Program was concerned that roots could increase the infiltration of water into radioactive sands encapsulated in the disposal cell. In 2002, LTSM Program scientists evaluated data collected during previous investigations to determine if contaminants are likely to leach from the radioactive sands and contaminate ground water if biointrusion altered the performance of the engineered cover. On the basis of the mineralogy of the encapsulated sands, low concentrations of contaminants in poor fluids, low concentrations of contaminant effluents from batch leach tests, and low concentrations of contaminants in ground water beneath the disposal cell, it is unlikely that any significant contamination will occur even if infiltration increases in the future.

Tuba City, Arizona, Infiltration Control Study

A water-balance model for the Tuba City, Arizona, disposal site indicated that enhanced recharge occurring along the southern toe slope of the disposal cell may be contributing to increased flow and contaminant transport in the ground water beneath the cell. The disposal cell cover consists of a compacted soil layer that is overlain by a gravel drainage layer and a basalt riprap cap. Evaluation of the design and neutron hydroprobe monitoring of soil water indicate that precipitation rapidly infiltrates the basalt riprap and flows laterally in the underlying gravel drainage layer to the southern toe slope, and then the concentrated flow at the base of the toe slope recharges the aquifer.

A study was initiated in 2000 in collaboration with the University of Arizona to determine if planting deep-rooted native species with relatively high evapotranspiration rates could control recharge along the toe of the disposal cell. Nine pairs of test plots were established; each pair consists of one plot of transplanted four-wing saltbush and one plot of no vegetation. Neutron hydroprobe ports were installed in the center of each plot. Soil moisture is monitored monthly, and the survival and growth of transplants are evaluated annually.

Monument Valley, Arizona, Vadose-Zone Flux Meters

LTSM Program scientists collaborated with Pacific Northwest National Laboratory personnel on the demonstration of a prototype vadose-zone water flux meter at the former Monument Valley, Arizona, Processing Site to evaluate the effect of evapotranspiration on ground water recharge. No commercial sensors are currently available that directly measure water flux in unsaturated media.

Three flux meters were installed at a depth of about 3.7 meters in an area that had been planted with native shrubs as part of a phytoremediation study. The instruments were installed to test the hypothesis that a planting of four-wing saltbush is not only extracting ammonium and nitrate from the soil but also transpiring enough water to prevent recharge to ground water. The two water flux meters placed within the planting area registered zero recharge during 2002. In contrast, a cumulative total drainage of 3.75 centimeters was recorded with a flux meter placed outside the planting area. The difference is attributed to plant transpiration.

LTSM Program Disposal Site Characteristics

Disposal Site	Site Area (acres)	Cell Area (acres)	Cell Volume (1,000 cubic yards)	Total Activity of Radium-226 (curies)
Uranium Mill Tailings Radiation Control Act Title I				
Ambrosia Lake, New Mexico	290	91	5,162	1,850
Burrell, Pennsylvania	72	4	73	4
Canonsburg, Pennsylvania	34	6	192	100
Durango, Colorado	120	60	2,533	1,400
Falls City, Texas	231	127	6,019	1,277
Grand Junction, Colorado[a]	360	60	4,034	Undetermined
Green River, Utah	26	6	382	30
Gunnison, Colorado	115	29	796	175
Lakeview, Oregon	40	16	944	42
Lowman, Idaho	18	8	126	12
Maybell, Colorado	250	66	4,100	455
Mexican Hat, Utah	119	68	3,483	1,800
Naturita, Colorado	27	10	399	79
Rifle, Colorado	205	71	3,757	2,738
Salt Lake City, Utah	100	54	2,710	1,550
Shiprock, New Mexico	105	77	2,800	746
Slick Rock, Colorado	62	12	857	175
Spook, Wyoming	14	5	315	125
Tuba City, Arizona	145	50	1,631	940
Uranium Mill Tailings Radiation Control Act Title II				
Bluewater, New Mexico	3,300	320	18,000	12,330
Edgemont, South Dakota	360	100	3,000	527
Sherwood, Washington	380	100	2,150	470
Comprehensive Environmental Response, Compensation, and Liability Act				
Monticello, Utah	119	86	2,600	2,780
Weldon Spring, Missouri	217	45	1,480	6,570
Nuclear Waste Policy Act Section 151				
Parkersburg, West Virginia[b]	15	12	Less than 20	Unknown

[a]A portion of the Grand Junction, Colorado, Disposal Cell continues to receive radioactive material.

[b]The precise quantity of radioactive material in the Parkersburg, West Virginia, Disposal Cell is unknown; therefore, the total activity is unknown.

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Resources

U.S. Department of Energy (DOE) Office of Environmental Management: This website provides descriptions of many of the DOE remedial action programs under which sites in the Long-Term Surveillance and Maintenance (LTSM) Program were remediated and has information on individual sites. **http://www.em.doe.gov/**

Long-Term Stewardship Information Center: This website presents references describing stewardship activities and resources within DOE. **http://lts.apps.em.doe.gov//**

LTSM Program Website: This website contains fact sheets for LTSM Program sites, long-term surveillance plans, site status reports, links to applicable or relevant and appropriate regulations, and other information. **http://www.gjo.doe.gov/programs/ltsm/**

Lasting Legacy: This website provides descriptions of the DOE weapons complex, plans for each site, and discussions of stewardship issues.
http://www.lastinglegacy.net/legacy3.1/loadup.htm

U.S. Environmental Protection Agency Alternative Cover Assessment Program Activities Summary: Summaries of the work of the Alternative Cover Assessment Program are available at this website. **http://www.rtdf.org/public/phyto/minutes/altcov/default.htm**

State and Tribal Governments Working Group: This stakeholder organization, sponsored by DOE, has been active since 1989 in promoting sound stewardship practices for DOE sites after remediation is complete. **http://www.em.doe.gov/stgw/**

National Governors' Association: This website contains information about long-term stewardship activities being implemented across the DOE nuclear weapons complex and contains links to other stewardship sites. **http://www.nga.org/nga/**

Energy Communities Alliance: This site addresses the role of local governments in stewardship of DOE sites. **http://www.energyca.org**

Consortium for Risk Evaluation with Stakeholder Participation: This organization is working to foster a broader and deeper understanding of risk-related issues that concern waste cleanup. This initiative involves multiple areas of investigation.
http://www.cresp.org

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